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Science and Art Department.

GENERAL

DESCRIPTIVE NOTICE

OF THE

INDUSTRIAL MUSEUM OF IRELAND

AND

GOVERNMENT SCHOOL OF SCIENCE,

STEPHEN'S-GREEN, DUBLIN,

INDICATING

The Objects, Nature, and Classification of the Technological and Geological Collections, and the Arrangements for Industrial Education in the Scientific Departments.

DUBLIN:
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1866.

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INTRODUCTORY NOTICE

OF THE

ORIGIN AND GENERAL OBJECTS OF THE MUSEUM.

IN the year 1845 it was decided by Her Majesty's Government* to establish in Dublin an institution somewhat on the plan of the Museum of Practical Geology in London, but more extended in its objects, as embracing the general range of the industrial arts; and the new institution was placed under the department of the Right Honourable the Chief Commissioner of Woods and Forests.† The house No. 51, Stephen's-green, Dublin, having been soon after purchased for the buildings of the new Museum, and Sir Robert Kane having been appointed Director, some of the collections which were intended to form part of the Museum, were deposited in the building, and were made, as far as possible, available for scientific purposes, and for public inspection. The original building having been, however, only that of a private house, it was necessary to provide a series of proper museum galleries, a lecture theatre, chemical laboratories, &c., before the exhibitional and other departments of the institution could take their final form, or manifest their proper efficiency. The erection of the new galleries and other buildings was accordingly commenced in 1847; but owing to the execution of these works being spread over a period of more than four years, it was not until 1852 that the buildings attained the state of completion which admitted of the definitive arrangement and classification of the several collections being commenced. Ever since that time, however, the work of organization, and the acquisition of new materials for the collections, has steadily progressed; and, in addition to the more purely exhibitional department, to which the galleries are devoted, there have been established also, as portions of the institution, the Government School of Science, and a special chemical department, with laboratories, for carrying on such scientific researches as might be required for the public service, and also for giving instruction in practical and analytical chemistry. These several departments will be more fully noticed further on.

* The late Sir Robert Peel, Bart., being Prime Minister.

† The Duke of Newcastle, then Earl of Lincoln, being Chief Commissioner.

In March, 1853, the Industrial Museum was transferred from the Department of Works, under which it had been since its foundation, to the Department of Science and Art, then newly created as a branch of the Board of Trade. In the year 1857 the Department of Science and Art was transferred from the Board of Trade to the Committee of Privy Council for Education, Science and Art Department, and the Industrial Museum has consequently remained since then under the supreme direction of that branch of the Government. The staff of the Museum and School of Science consists of the following officers at present:—

Director—Sir Robert Kane, F.R.S., M.R.I.A.

Professors.

Geology—J. Beete Jukes, M.A., F.R.S., F.G.S., M.R.I.A.
Physics—William Barker, M.D., M.R.I.A.
Chemistry—William K. Sullivan, PH.D., M.R.I.A.
Practical Chemistry—Robert Galloway, F.C.S.L.
Botany—Geo. Butler Bradshaw, F.R.C.S.I.
Zoology—John Morgan, F.R.C.S.I.

Chemist—Robert Galloway, F.C.S.L.
Curator—Alphonse Gages.
Assistant Chemist—William Plunket.
Clerk and Accountant—George C. Penny.

By the title of Industrial Museum of Ireland it is not intended to imply that the collections or objects of the institution are exclusively industrial, or exclusively Irish. The great object for which the Museum was founded, however, being the representation of the physical structure and capabilities of Ireland, and the diffusion of sound scientific instruction as to the means by which the resources of the country could be most usefully applied, and the popular mind directed to subjects of permanent utility and practical value, the collections of strictly Irish specimens of geological or industrial interest naturally form the nucleus around which there is grouped and arranged all that can illustrate either the deficiencies or the riches of this country; all that can explain the uses to which its raw materials can be applied; the processes they pass through; and generally, the various series of specimens by which the condition and progress of the industrial arts, both at home and abroad, can be satisfactorily illustrated by the professor, and comprehended by the student.

The exhibitional departments of the Museum may be considered, therefore, as falling under two principal heads:—

first, the specially geological collections; and second, the specially industrial collections.

The geological collections, as displayed in the galleries, consist principally of those formed by the officers of the Geological Survey of the United Kingdom, especially in Ireland; but also with such typical collections from the British Survey, and from Continental sources, as shall render the entire a satisfactory representation of the geological structure and resources, not merely of Ireland, but of the United Kingdom, and of Europe generally. Those collections, of which but a portion has been, as yet, arranged for exhibition, are placed in the special charge of the officers of the Geological Survey while in process of formation, and while the Geological Survey is in progress. Some further explanations of the condition and arrangements of those collections will be found in the notice supplied by Mr. J. Beete Jukes, the Local Director of the Geological Survey of Ireland, and Professor of Geology in the School of Science, which is appended further on.

The galleries of the Museum being built in two stories, a primary classification is made—into objects of inorganic nature, which are arranged in the lower galleries; and objects of organic nature, which are arranged in the upper galleries. In one instance this principle of classification is not strictly observed. The collection of specimens of fossil fuel (peats, lignites, and coals, with their products and applications), although properly belonging to those of organic nature, are yet placed in the lower north gallery. For this there are two reasons:—first, that the most important fossil fuels are so closely connected with metallurgical operations, especially that of iron, with the principal ores of which metal also the coal deposits possess important geological relations, that the industrial history of the metals and of the fuels could scarcely be separated without practical inconvenience; and second, that although of organic origin, the fossil fuels represent so characteristically the transition from organic to mineral nature that they may very suitably be taken, as they actually are taken in the Museum, as forming the connecting link between the true mineral substances and the vegetable tissues (woods and fibres) with which the collections in the corresponding upper gallery commence.

On each floor of the Museum are three galleries, which are distinguished respectively as the cross gallery and the north and south galleries. The main entrance to the Museum from Stephen's-green opens through the marble hall into the centre of the lower cross gallery. From this the north and south

lower galleries pass, and terminate at their east ends in staircases, by which the upper and lower series of galleries are connected. The general plan of arrangement may be simply described, but it must be borne in mind that the entire system of classification and arrangement of the special collections is still in progress, and consequently liable to frequent alteration, according as new acquisitions are made, or as specimens are replaced by others better adapted for scientific or industrial instruction.

The entrance hall of the Museum is employed for illustrating the applications of Irish marbles to the purposes of decorative architecture.

The lower cross gallery is devoted to collections illustrative of materials used in the arts of construction, such as the building stones of Ireland and England, flags, slates, cements, marbles, porphyries, serpentines, &c. Some materials of this class, of too massive a character for this gallery, will be found near the staircase at the end of the lower south gallery.

The lower south gallery is occupied partly with geological and partly with metallurgical and mineralogical collections. The geological collections are those intended to illustrate the lithological characters, and the history of the non-fossiliferous rocks. The metallurgical collections represent the geological position and nature of the ores, the metallurgic treatment, the uses, and derived compounds of copper, lead, zinc, tin, antimony, silver, and gold; the processes and results of electrotyping, and the applications otherwise of those metals to industrial uses.

The mineralogical collection, which has been formed principally with a view to the practical uses of minerals, is in process of arrangement, according to the classification of Dufresnoy.

At the end of the lower south gallery are placed some very massive specimens, one being a mass of the rock-salt obtained from the new salt mines opened near Belfast, by the Marquess of Downshire, and those at each side of it being blocks representing the two thickest beds of coal in the Kilkenny (Leinster) coal-field—viz., the three-foot seam and the four-foot seam.

The lower north gallery is devoted to the illustration of the history of the iron manufacture, of fuels, of the mineral-chemical manufactures, and of the manufacture of pottery and glass.

The Irish fuels and their products are shown from the most recent peat to the mineralised stone-coal, or anthracite, of which the principal coal-fields in Ireland consist. The

iron-stones of the several Irish coal-fields are given; and in connexion with the Connaught coal-field the ores which occur at Arigna, on Lough Allen, in Leitrim, and specimens of the iron manufactured at that place are shown. Among the products obtained from fuels, the oils and solid fats (parafine) employed for making candles, as substitute for wax or spermaceti, will be found.

In connexion with the history of the iron manufacture in Great Britain, illustrations of the coals and clay iron-stones of the several coal-fields of Great Britain are given, and of the varieties of oxides (hematites) and carbonates of iron employed as ores for iron-smelting. Series of specimens of the manufactured iron, as pig, bar, and sheet, illustrating the manufacture as carried on in the most important localities, as Lanarkshire (Monklands), Shropshire (Coalbrookdale), Staffordshire (Wolverhampton), and Yorkshire (Lowmoor), will be found arranged in connexion with the coals and ores.

Illustrations of the manufacture of various classes of objects of iron and steel, from railway axles to needles, are exhibited.

The mineral-chemical manufactures illustrated, are principally those founded upon or derived from the employment of the iron pyrites (or sulphuret of iron) as a source of sulphuric acid; this mineral being found and worked in great abundance in the Ovoca district of the county Wicklow, and affording extensive employment. The manufactures of sulphur and sulphuric acid, of sulphate of soda, and carbonate of soda, of sulphate and carbonate of magnesia, sulphate of iron and alum, and other derivative chemical products, are illustrated.

A collection of specimens belonging to this class, illustrating the sources and properties of the earth alumina and the metal aluminum, together with the manufacture of artificial ultramarine and the alumina lakes, are at present deposited in the lower cross gallery until the arrangements for the department of chemical manufactures are more fully carried out.

In the lower north gallery is contained the collections illustrating the manufacture of pottery, porcelain, and glass. These collections may be considered as embracing three divisions, viz.:—first, a historical series showing the varieties of the manufacture from the earliest times; second, a series illustrating the diversity of manufacture and decoration in various countries; and, third, a series illustrating the chemical and mechanical materials, processes, and instruments employed in the manufacture, especially as carried on in England. Specimens of the pottery manufactured in Ireland, and of the clays, &c., employed, are also given.

A small, but very instructive, series of enamels serves to

illustrate the various styles and materials employed in that interesting art; and there are specimens of Byzantine and Limoges enamels, and modern applications of enamelling, both Chinese and European.

The application of stained and painted glass to decorative purposes is shown by the beautiful window presented by Mr. John Gibson, of Newcastle, and placed at the end of the north galleries, and also by that constructed by Messrs. O'Connor, formerly of Dublin, now of Berners-street, London, placed in the lower cross gallery, opposite the entrance from the hall.

The upper north gallery is devoted to collections illustrating the industrial applications of vegetable and animal substances. The series begins with the woods, then passes to fibres, in which the flax fibre, which is the basis of the great linen manufacture of Ireland, occupies a prominent place. The flax fibre is traced, and its uses shown from the stage of the growing flax plant, the flax prepared for spinning, the yarn, the linen cloth of various qualities and classes; the rags and the paper made from them, and the papier-mache prepared from refuse paper, which, when varnished, gilt, and inlaid with pearl and painted with flowers, forms so ornamental a branch of manufacture.

The history of cotton is similarly treated, and a similar exposition of the silk manufacture is in progress, but is at present limited to the illustration of that branch of the silk manufacture which is extensively carried on in Dublin—viz., that of poplin or tabinet. The sources, modes of manufacture, and applications of caoutchouc and gutta percha, are also very fully illustrated.

The series of woollen manufactures is in progress of formation, but has not yet been nearly completed. The collections of the different varieties of wool and hair, and their applications, are, however, already extensive. The industrial applications of animal substances are further illustrated by the preparation of feathers, horn, bones, &c.

A case is devoted to the history of the varieties of starch and sugar, of fatty bodies, animal and vegetable, and of their uses. The collections of materials and products of the manufacture of leather and of dyeing materials, are but partially arranged as yet.

The upper south gallery is devoted exclusively to the palæontological collections of the Geological Survey—the explanations regarding which will be found further on.

The upper cross gallery contains a collection, which is but now in process of formation, of models of the different kinds of boats, nets, and other equipments employed in the fisheries

on the coast of Ireland. In connexion with it will be arranged illustrations of the fish usually caught in the Irish seas, the baits, &c., employed in the fishery.

This gallery contains, at present, a collection of birds, of fishes, shells, and other objects of natural history, of which only a portion, not yet separated, has any immediate industrial relations. This collection, together with a collection of the rocks and minerals of the north of Ireland, was formed during the progress of the Geological Survey of Ireland, under the direction of the late General Portlock, R.E., when that Survey was carried on as a part of the General Topographical Ordnance Survey, and was made to embrace the General Natural History of the country. The mineralogical and geological specimens have found their place with the other collections, since formed by the Geological Survey, and in the Museum; but the zoological and botanical collections are preserved so far separate, as the period for the final arrangement had not yet arrived.

For the more perfect illustration of the mechanical and chemical processes employed in the industrial arts, an extensive series of models of machinery, furnaces, and other constructions, on a correct scale, is in preparation. Those which have been as yet finished, and are deposited in the galleries, will serve to indicate the manner in which it is intended to carry out this department in its several branches. Thus—

1. *Of Mining Machinery and Constructions.*—A working sectional model of a mine shaft, showing the mode of timbering; the winch or horse-gin, for elevating the ores; and the ladders and machine-lift, by which the workmen ascend and descend.

2. *Of Iron and Steel Manufactures.*—Models of the high furnaces for iron smelting, and of furnaces for the manufacture of cast and of bar steel.

3. *Of Pottery and Earthenware Manufacture.*—Models of the furnaces or kilns employed in the potteries in Staffordshire, for baking and firing the ware, and of the glazing or enamelling furnace.

4. *Of Chemical Manufactures derived from Sulphur and Common Salt.*—Models of leaden chambers and kilns for making sulphuric acid. Salt cake (sulphate of soda) furnaces, and chloride of lime, stills and condensers, as at present used in the best constructed factories.

5. *Models,*[*] with sections of the improved furnaces employed for the smelting of lead ores at the works of the Mining Company of Ireland, Ballycorus, county Dublin.

A series of models of the lathes and tools employed in

the shaping, working, and modelling the several kinds of pottery.

An extensive series of models, made to scale by M. Clair of Paris, of the furnaces and constructions employed in the processes of metallurgy of the ores of copper, lead, and zinc.

In the upper south gallery are deposited a series of models of looms and machines, being the commencement of the series to illustrate the processes of the textile manufactures. The models, as yet completed, belong to some forms of silk and worsted manufacture, which are carried on in Dublin, as velvet, poplin, or tabinet, carriage lace, girths, &c. In connexion with them, a series of illustrations of the preparation of silk from the cocoon, and of the natural history of the silkworm, has been arranged for exhibition.

Connecting the eastern extremities of the north and south ranges of galleries, and closing the quadrangle of the building, is the lecture theatre, in which the Professors of the Museum deliver their courses of instruction. The subjects on which lectures are delivered, are Geology (including Physical Geography), Natural Philosophy, Theoretical Chemistry, Practical Chemistry, Zoology, and Botany. Of the courses of lectures delivered some are of a more elementary character, and are open to the public. Others belong to a regularly framed curriculum of studies, followed by students who are registered on entrance, and are submitted to examinations at the end of the course, when prizes are awarded for superior merit. This systematic course of industrial education, constitutes the object of the Government School of Science.

A special programme of those educational arrangements is published, and may be had on application at the Museum.

The Museum possesses a select library of scientific reference for the use of the Officers and Professors, to which the students of the Government School of Science are admitted, under certain regulations.

In the offices of the Museum is deposited a series of maps connected with Ireland, including those of the Ordnance Survey; a series of coloured maps, showing the distribution of the values of land in the Irish counties, according to the official valuation; and a series of agronomical maps showing the nature and distribution of the agricultural soils in some of the Irish counties from which the materials for that investigation were obtained.

The Chemical Department of the Museum consists of two ranges of laboratories: one in immediate connexion with the Museum galleries, which is devoted to the more delicate operations of research, and to analytical instruction; and the

other, in the basement story, appropriated to the metallurgic and other furnace operations, and preparation of materials, re-agents, &c. A portion of this laboratory is also fitted up for the practical instruction of pupils. By means of this department chemical analyses of rocks and minerals, ores, soils, &c., when required for the purposes of the Museum, or for other objects of scientific inquiry, or for the purposes of the public service, are carried on; and reports are made to the heads of the department under which the Museum is placed, or to the other departments of Government from which scientific references for information are made. The chemical examination of the various materials and products belonging to the industrial arts, exhibited in the galleries, and inquiries suggested by their circumstances and properties, forms, naturally, a main portion of the duty of this important branch of the institution. This chemical department is specially under the charge of Mr. Robert Galloway, Chemist to the Museum.

For the purpose of affording explanation as to the nature, history, and uses of individual specimens in the Museum collections, it is preferred to attach to the objects labels, affording the necessary details, and thereby to avoid the necessity of reference to the pages of an extensive and complicated catalogue; the more so, as from the continual changes which occur among the specimens of a museum in process of organization, any catalogue in detail must become, to a certain extent, inapplicable after a short time. A system of very full and explanatory labelling of the specimens has, therefore, been carried out by the Curator of the Museum, Mr. Alphonse Gages; but in order to afford, as far as possible, further and more extensive information as to the classes of objects in the Museum than could be given upon the labels, the several officers of the institution, connected with the departments of science, to which the collections respectively belong, have prepared general descriptions of those collections, and a detailed catalogue, or inventory of the contents of the Museum is also in preparation. An explanation of the arrangements of the Geological collections, drawn up by Mr. Jukes, Local Director of the Geological Survey and Professor of Geology, is annexed to this introductory notice.

It will, however, be understood that those general descriptions do not in any way pretend to the character of a full or detailed catalogue of the objects contained in the Museum, or of a complete explanation of the history or properties of such as are individually referred to. On the present occasion it is only sought to supply such a popular guide to the collec-

tions as, in conjunction with the system of descriptive labels, may enable any ordinary visitor to understand the objects and the uses of the institution, and to become acquainted with the nature of its contents. By such means it is believed that a great deal of valuable instruction in the industrial sciences may be conveyed, and the advantages of further systematic study made evident; those descriptions will be, of course, rendered more and more complete, according as the organization of the Museum progresses.

For the purpose of estimating approximately the amount of time which may be required for the complete numbering, labelling, and cataloguing the collections of the Museum, the Curator, Mr. Gages, has made the following estimate of the numbers of individual specimens in the several principal divisions:—

In Lower Cross Gallery, . . .	2,198
In Upper ditto, . . .	890
In Lower North Gallery, . . .	4,220
In Upper ditto, . . .	3,519
In Lower South Gallery, . . .	3,890
Total in the Technological Portions of the Museum, .	14,717

To this there are to be now added the Trade Collections of Mr. Simmonds, recently purchased, about 4,000 specimens, making the total number of specimens in the Industrial Collections to be 18,717, exclusive of the Palæontological Collections of the Geological Survey, about 7,500 specimens, in the Upper South Gallery, and the several collections of rocks—viz., the Portlock Collection, about 1,000; the Krantz Collection, about 666; and that collected by the officers of the Geological Survey, about 750 specimens; making a total of specimens in the Geological departments of about 9,916 specimens, and in the Museum altogether about 24,633 specimens. There are also special collections of specimens and apparatus formed by the Professors, and in their personal charge, for illustrating their courses of lectures.

The museum galleries were open on all week days from 11 to 4 o'clock, during which time there visited the day collections, from 1st January to 31st December, 1865, 29,665 persons, being an increase of 3,910 on the similar number for the preceding year.

The galleries were also open to the public on the evenings when lectures were delivered from 7 till half-past 9 o'clock,

and during the winter months in addition on Mondays and Thursdays within the same hours. The total number of visitors in the evenings for the year 1865 was 15,612, making the total number of visitors in the year 45,277, being an increase of 9,135 on the similar number for the preceding year.

R. K.

THE PALÆONTOLOGICAL GALLERY.

The collections of fossils in this gallery consist of—

1st. A selection of specimens from the collection made by the Geological Survey of Ireland.

2nd. A set of duplicates from the English collection, sent over from the Museum in Jermyn-street.

3rd. A duplicate set of fossils from the north of Ireland, collected by the Ordnance Survey, under the direction of Colonel Portlock.

The following is the general plan on which these collections are arranged :—

Commencing with the north-west corner of the gallery, the fossils of the lower formation are placed there, and the ascending order proceeds along the north side, round by the east end, and terminates with the highest and newest formations at the south-west corner of the gallery. The northern half of the gallery is devoted to the Irish Palæozoic formations. The southern half of the gallery contains the British Palæozoic, Secondary, and Tertiary collection, and the Irish Permian, Lias, Cretaceous, and Tertiary collections.

Commencing at the north-western corner of the gallery, the first small table case and small wall case contain Cambrian fossils, Oldhamia from Carrick, Bray, and Howth; tracks and burrows of annelids from Bray (the latter collected and presented by Dr. Kinahan). The second and third table cases contain Lower Silurian fossils ; those from the counties of Meath, Tipperary, Kerry, and part of those from Dublin on the south side, those from the Chair of Kildare and the other part of those from Dublin on the north side. In the wall case are Colonel Portlock's collection of Lower Silurian fossils, from Tyrone and Fermanagh, &c., on the lower shelf, and on the upper, part of the collection of the Geological Survey, from the counties of Wicklow, Wexford, and Waterford.

In the fourth and fifth table cases are the collections made

by the Geological Survey, from the Upper Silurian rocks of the Dingle promontory; and at the end of the wall case opposite, those from the Upper Silurian (Llandovery rocks) of Galway and Mayo.

In the eastern half of the gallery the sixth table case contains a series from the Carboniferous slate and Coomhola grits of Cork, &c.; and in the opposite wall case is the collection from the upper part of the Old Red Sandstone of Kiltorcan, county Kilkenny. The remainder of the wall case is occupied by the duplicates of the collection of Carboniferous fossils, made by Colonel Portlock in the north of Ireland. The other table cases, 7th, 8th, and 9th, are occupied by part of the Carboniferous collection made by the Survey in the south of Ireland.

The cross table at the end of the gallery contains Irish Coal Measure fossils. Returning to the west end of the gallery for a moment, and proceeding along the northern side of the southern row of table cases, we take up the British Palæozoic series, in the small table case, containing Cambrian fossils from Longmynd, and the Lingula flags and lowest Llandeilo fossils, from North Wales; and proceeding towards the east, the British duplicates will be found arranged opposite their respective Irish congeners, till we reach the Coal Measures at the eastern end of the gallery.

Then, turning round to the passage between the table cases and the wall case, we have, along the south side of the eastern table cases, the British Permian fossils, the Irish Permian (partly collected by Colonel Portlock, partly presented by Professor King), and the Irish Lias, collected by Colonel Portlock; while in the wall case are arranged the British Oolitic series, from the Lias to the Purbecks inclusive.*

In the space at the eastern end of the wall case, however, near the head of the stairs, are some large slabs—one showing the footprints of a Labyrinthodon, from the Triassic rocks of North Cheshire, one a large slab of Extracrinus in iron pyrites from the Lias, and the others large annelid or molluscan tracks in the flags of the Coal Measures from Kilrush and Kilkee.

In the south-western division of the gallery we have, on the south side of the table cases, the Irish Cretaceous series, collected by Colonel Portlock, and the Irish Pleistocene and recent specimens collected by the Survey.

In the corresponding wall case is the collection of British duplicate fossils of the Upper Secondary (Wealden and Cretaceous) rocks; those of the Eocene formations, including

* The great Oolitic series contains a set given me, some years ago, by my friend, Mr. Lycett, of Minchinhampton.—J. B. J.

a good set of duplicates from the late Professor Edward Forbes's labours in the Isle of Wight, and a set from the Crag.

In the centre of the west end of the gallery is a specimen of the Megaceros Hibernicus, presented to the Museum by the Right Honorable the Earl of Mayo, and in the small wall case are several bones of the same animal, presented by Lady Elizabeth Butler.

Along the floor compartments of the wall cases are ranged those specimens of the respective formations which are too bulky to be placed on the shelves.

THE COLLECTION OF ROCKS.

This is contained in the wall cases of the lower south-eastern gallery. It consists of—1st, a large series of rocks, collected principally by the Geological Survey in the south of Ireland; 2nd, a series collected by the Ordnance Survey, under Colonel Portlock in the north of Ireland; 3rd, a series of European rocks, purchased for the Museum, from Mr. Krantz, of Bonn.

The collection made by the Geological Survey is arranged as follows:—

In the northern wall case, at the end next to the window, come a few of such common minerals as are the ordinary materials of which rocks are formed.

Then come the Igneous rocks—1st, the Lavas; 2nd, the Traps; and 3rd, the Granites. With the Lavas and Trappean rocks are arranged some of their typical "ashes" or contemporaneous fragmentary accompaniments. The Lavas are, of course, brought from abroad. The Traps are principally Irish, with some British illustrative specimens. The Granites are, in like manner, chiefly Irish.

Next to the Granites are placed the specimens of Gneiss and Mica schist as being crystalline metamorphic rocks, with a schistose structure; and next to those the Slates, as being altered by pressure.

At the end of the wall case are arranged specimens of coal, chalk, sandstone, and other rocks, which have been altered by the local contact of igneous rocks.

In the southern wall case are arranged the Aqueous rocks; at the east end, and at the end next the stove, are placed the picked specimens of Krantz's European series.

The Aqueous rocks consist of—1st, the rough mechanically-formed rocks, the breccias and conglomerates, next the sandstones, and then the clays or argillaceous rocks. Some

nodular concretionary structures are introduced here and there, showing the mode of occurrence of iron-stone, for instance, in clay rocks.

Next to the clay rocks are placed the limestones, commencing with a fine series of Stalactites from the Mitchelstown caves, and embracing some characteristic specimens of the French tertiary limestones, the French and English oolitic limestones, and the Irish carboniferous limestones, of which some have also an oolitic structure.

The Magnesian limestones come next, after which are placed the Gypsums or sulphates of lime.

Lastly, some few characteristic specimens of lignite and coal.

For the principal varieties of coal and iron-stone, however, the visitor must seek the western end of the north lower gallery, where they are arranged, not so much geologically as with a view to their economic use.

Colonel Portlock's collection of rocks contains some valuable specimens of the typical rocks of the north of Ireland; but want of space to arrange it has compelled its being transferred to the upper shelves of the south side of the gallery.

Krantz's collection of European rocks consists chiefly of Igneous and Metamorphic rocks. It is placed partly on the shelves of the south-eastern wall case, near the fireplace, and partly in drawers under the table cases. It contains some interesting specimens both of the rocks of which examples are to be found in the British Islands, and of those which are not. Among the latter, attention may be more particularly called to the series of trachytes, to the lavas from Vesuvius and other places, and to the melaphyres and diorites, and the so-called wackes (or ashes or tuffs) accompanying these. The series of specimens of gneiss and those of syenite, especially of zircon syenite, and also of serpentine, gabbro, variolite, omphacite, eclogite, garnet rock, &c., are also interesting.

At the foot of the stairs may be seen a great block of rock-salt, from the Duncrae mines, near Carrickfergus, presented by the Most Hon. the Marquess of Downshire, flanked by two sections of Kilkenny coal from Castlecomer, presented by the late J. B. Wandesforde, esq.

On the north wall, on each side of the stove, are columns from the basaltic rocks of the county Antrim, on which are some specimens of basalt (Rowley rag) melted and cast by Messrs. Chance, near Birmingham—one being a sheet of rolled basaltic glass, one a piece of cornice moulding, and one lion, as architectural ornaments.

On the south side are some large blocks of anthracite, from Doonane, Queen's County, presented by Benjamin

Edge, esq., and one from Llanelly, Carmarthenshire, having a polished surface.

Under the stairs may be seen, on the north side, part of a granite vein, with its walls of altered Silurian slate, from Killiney hill, procured through the kind instrumentality of Matthias O'Kelly, Esq. There is also a specimen of polished hornblende rock, from County Monaghan, presented by Lord Rossmore; and one of polished red granite from Barnemore, County Donegal.

Against the wall are arranged some large slabs of slate from Donegal and Killaloe, and a slate table, &c., from Valentia, presented by Mr. Blackburn, on the part of the Valentia Slate Company. Near the door of the physical preparation room, are a block and slab of white marble, from Dunlewey, Donegal.

J. B. J.

GOVERNMENT SCHOOL OF SCIENCE APPLIED TO MINING AND THE ARTS, DUBLIN.

ROYAL EXHIBITIONS.

1. There are ten Royal Exhibitions of the value of £50 per annum entitling the holders to free admission to all the lectures and the Chemical Laboratory at the Government School of Science, to be held from year to year for three years, on the condition that the holder attends the lectures regularly during those years and passes the examinations required for the associateship of the School.

At the May, 1867, examination three of the above Royal Exhibitions to the Government School of Science will be open for competition independently of the prizes, &c., offered by the Science and Art Department.

All persons over 21 years of age, excepting artisans, and such as come within the category of persons paid upon under the Science Directory, will be excluded from competing for the Royal Exhibitions. Special cases, however, must be determined according to the spirit of the rules and the object of the endowment.

The competition for the Royal Exhibitions will be determined by affixing the following values to the several results of the May Examination, viz. :—

To a 1st grade Queen's Prize, in any subject,	. . .	9 marks.
To a 2nd " " "	. . .	7 "
To a 3rd " " "	. . .	5 "
To an honorable mention, "	. . .	3 "
To a pass, "	. . .	1 "

And in addition—

For a gold medal, "	. . .	10 "
For a silver medal, "	. . .	7 "
For a bronze medal, "	. . .	5 "

N.B.—All Candidates for Royal Exhibitions must have obtained at least a Third Class in Elementary Mathematics before they are eligible to obtain them.

Science Certificated Teachers may compete for the Royal Exhibitions. When coming up simply with this object they should inform the Science and Art Department, so that their names may not appear in the published list with the students.

FREE ADMISSIONS.

2. Free admissions to the lectures at the Government School of Science in Dublin are granted to any person who takes a gold medal in the May Examination.

PROGRAMME.

THE systematic courses of scientific lectures delivered in the theatre of the Industrial Museum of Ireland, commencing with the Session of 1854–1855, may be considered as the first fully organized arrangement carried out in Dublin to provide those who are occupied in the day time with the means of employing their leisure hours in the evening in learning thoroughly the more practically useful branches of science. The success of the experiment, notwithstanding that the advantages offered could not at the outset have become generally known, has been such as to fully call for a continuation of it during the succeeding session.

But while the education of that numerous and important portion of the public will be provided for, it was proposed to extend still further the utility of those educational arrangements for the future, by establishing corresponding courses of lectures on the several departments of applied science, to be delivered during the day, and the arrangements adopted for that object have been found so successful, that they will be continued in the approaching Session, with only such slight modifications in detail as experience has proved to be desirable.

DAY AND EVENING CLASSES.

In the session of 1866–1867, accordingly, there will be two distinct and independent series of courses of lectures—the one to be delivered in the daytime, the other in the evening. The number of lectures in each course will be found annexed.

DAY COURSES OF PUBLIC LECTURES.

Zoology.—Dr. Morgan will commence a course of six public lectures on Zoology, on Tuesday, 9th October, at four o'clock, P.M.

Geology.—Mr. Jukes will commence a course of six public lectures on Geology, on Tuesday, 30th October, at four o'clock, P.M.

Chemistry.—Dr. Sullivan will commence a course of six public lectures on Chemistry, on Tuesday, 13th November, at four o'clock, P.M.

Physics.—Dr. Barker will commence a course of six public lectures on Physical Science, on Tuesday, 27th November, at four o'clock, P.M.

Day Classes.

Practical Chemistry.—A course of Analytical and Practical Chemistry will be commenced by Mr. Galloway in the laboratory on Wednesday, the 10th October.

Evening Courses of Public Lectures.

Chemistry.—Dr. Sullivan will commence a course of twelve public lectures on Chemistry, on Wednesday, 10th October, at eight o'clock, P.M.

Geology.—Mr. Jukes will commence a course of twelve public lectures on Geology, on Monday, 12th November, at eight o'clock, P.M.

Physical Science.—Dr. Barker will commence a course of twelve public lectures on Physical Science, on Monday, 3rd December, at eight o'clock, P.M.

Zoology.—Dr. Morgan will commence a course of lectures on Wednesday, 2nd January, at eight o'clock, P.M., of which the first six will be public.

Botany.—Mr. Bradshaw will deliver a course of six public lectures on Economic Botany, *before* the Easter recess, on such days as shall be announced.

Practical Chemistry.—A course of twenty lessons on Practical Chemistry will be commenced by Mr. Galloway in the laboratory on Tuesday, February 5th, at seven, P.M. (The student is referred to the separate programme of laboratory arrangements for a more detailed account).

Systematic Educational Courses of Lectures.

Geology.—Mr. Jukes will commence a course of systematic educational lectures on Geology, on Tuesday, 11th December, at four o'clock, P.M.

Chemistry.—Dr. Sullivan will commence a course of systematic educational lectures on Chemistry, on Monday, 4th February, at four o'clock, P.M.

Physical Science.—Dr. Barker will commence a course of systematic educational lectures on Physical Science, on Monday, 1st April, at four o'clock, P.M.

Zoology.—Dr. Morgan will commence a course of systematic educational lectures on Zoology, on Wednesday, 2nd January, at eight o'clock, P.M.

Botany.—Mr. Bradshaw will commence a course of systematic educational lectures on Structural and Physiological Botany, immediately *after* the Easter recess; and, at its termination, another course on Systematic Botany, on such days as shall be announced.

During the period occupied by the latter course, and between its close and the examination of the class, the Professor of Botany intends to hold a series of excursions with the students, for practical field-instruction.

The session will commence on Monday, the 8th of October, 1866, and end on Wednesday, 19th June, 1867.

The Indian Telegraph Department now recognises the courses of lectures, as also the Practical Chemistry Classes connected with this Institution.

Registration and Fees.

No person will be considered eligible to compete for certificates or prizes unless he shall have registered himself as a student and paid the requisite fees.

The latest period for registration for attendance upon any course of instruction will be when one-third of such course shall have been delivered.

The office for registration of students is at the Industrial Museum, Stephen's-green, where Mr. G. C. Penny will receive the fees, enter the names of the students on the roll, and give cards of admission to the several courses, on every week day from eleven o'clock, A.M., to two o'clock, P.M., and on Monday evenings from seven to nine o'clock, P.M.

Students may register for one or more of the courses, and compete for the special certificates and prizes allotted to each course, but can only become eligible for a General Certificate by registration for and attendance upon a course in each of the four subjects, either in the day or evening classes.

A fee of 3*s*. 6*d*. will be charged for each of the systematic courses of lectures on Geology, Chemistry, and Physical Science; and 2*s*. for the lectures on Zoology or on Botany.

Examinations.

At the close of the courses of systematic lectures of each professor, an examination of the registered students will be held by the lecturer, and the names of those who pass it will be arranged and published in order of merit.

Students who have passed an examination, but not gained a prize, will be admitted to one more examination in the

same subject, after which they will not be deemed eligible for a prize in it.

Students who have once passed a General Examination will not be admitted to any further examination of any kind.

Certificates and Prizes.

Two kinds of certificates will be granted—

Pass Certificates will be given to such as pass each Special examination, whether Systematic or Practical.

General Certificates, stating the proficiency obtained in the several branches of study, signed by all the Professors, and countersigned by the Director, will be given to those who shall have passed all the Class Examinations within a space of two years.

The value of certificates testifying to a knowledge of the more practically useful branches of science will become daily more and more recognised; and already a very large number of the leading manufacturers of the United Kingdom have agreed to accept similar certificates as one of the highest testimonials which can be presented by persons seeking employment in their establishments. Every student should, therefore, strive to win such a certificate.

Prizes will be awarded to the first three names in the list of those who pass each examination, provided sufficient proficiency be shown.

These prizes will consist either of money, or of books stamped with the mark of the institution, or partly one and partly the other, at the option of the student.

The value of the prizes will be—

First prize, £5; second prize, £2; third prize, £1.

Practical Courses.

The sum of £8 will be awarded in prizes to the classes of Practical Chemistry, as will be arranged after the classes are formed.

No person having gained a Special prize will be deemed eligible again for a prize in the same subject.

The certificates will be awarded and the prizes conferred at a public meeting of the Institution, as will be arranged by the authorities of the Science and Art Department.

Evening Admission to the Galleries and Library of the Industrial Museum of Ireland.

Nothing tends so materially to familiarize the mind with scientific names, and to impress upon the memory the information acquired from books and lectures, as the examination

of the objects themselves, the study of whose properties or forms constitutes the basis of the experimental and observation sciences. This is especially true of natural history and geology, and, perhaps in an equal degree, of chemistry in its applications to industry. The collections illustrative of chemical compounds and chemical manufactures, and of geology, now in the galleries of the Industrial Museum of Ireland, are sufficiently extensive to be useful in this way. With a view, accordingly, of making them contribute as far as possible to public education generally, and especially to the development of the system of instruction established in the School of Arts and Manufactures, the galleries will be lighted with gas, and opened to the public on all the evenings of lecture during the session, and on such other evenings as shall be arranged, of which due public notice will be given.

With a view of facilitating the studies of those students who are occupied during the day, and cannot therefore visit any public library, access will be allowed to the library of the Industrial Museum of Ireland, which is provided with a number of suitable books in each department of science, selected by the respective professors. This library will be opened during the session at times and hours to be hereafter determined. The privilege of reading in this library must necessarily be exclusively confined to those students who desire to qualify for certificates by attendance upon all the courses, in one or other class, given during the session.

Recommendations to Students about their Preliminary Studies.

The best preparations for the study of any branch of science is the study of mathematics, not merely because it is itself the first of the fundamental sciences, and in some cases the most powerful and indispensable instrument of research, but even as a mere mental exercise. A familiarity with mathematical reasoning usually gives more definiteness and exactness of ideas, and leads the student to disregard the usual vague and loose statements which the untrained mind is apt to accept as science, while it teaches him to set most value in the experimental sciences upon numerical relations, not only as the most important in a theoretical point of view, but also in a practical one.

A knowledge of the four principal operations of arithmetic (addition, subtraction, multiplication, and division), vulgar and decimal fractions, the extraction of square and cube roots, ratio and proportion, and the elements of geometry, will enable a person to acquire a very good knowledge of experimental physics and chemistry. Without this amount

of knowledge, at least, many important points in both branches of science must be unintelligible, or at best must be very imperfectly understood.

And as it is impossible to have an accurate knowledge of animal and vegetable physiology, which are the basis of the other divisions of natural history, or of geology, without some previous knowledge of experimental physics and chemistry, this amount of elementary mathematics is equally necessary to the student who desires to pursue in an especial manner those branches of science.

There is one very simple truth which it is very desirable should be impressed upon the minds of students—namely, that in order to apply science to industry, it must be first learned; and that, consequently, the impression which commonly prevails, and which some, who ought not to do so, have helped to foster, that there is a kind of inferior science adapted for practical persons, is perfectly erroneous. Indeed, no one requires to know science so thoroughly as he who intends to apply it in his business. The kind of science which is capable of being applied to industry with advantage must therefore be, in reality, of a far higher character than what is required as an element of general education.

Persons who intend to register themselves as students of the School, with a view of applying the knowledge of science which they may acquire in some of the various branches of industry, such as mining, the construction of machines, textile and chemical manufactures, agriculture, &c., will do well to remember, that although the amount of mathematics mentioned above will enable them to acquire a vast amount of information in the subjects taught during the session, it will be far from sufficient to enable them to apply it with profit in industry. Such questions as the strength of materials; the flow of water, steam, or gas, through pipes; the construction of water-wheels and turbines; or the theory of machines in general, and similar questions which perpetually present themselves to the manufacturer, require for their solution a considerable amount of mathematical knowledge.

While it is to be hoped that no one will be discouraged from joining the classes of the ensuing session because they may not have previously studied the elementary mathematics, all who desire to acquire that accurate knowledge which alone is practically useful, should endeavour, either by self-instruction, or through the many facilities which exist for the purpose, to learn, at least, the most indispensable branches of elementary mathematics.

With a view of pointing out the extent of mathematics which it would be desirable that students who intend to

become mining engineers, ship-builders, machinists, or managers of factories generally, should possess, before commencing the study of the experimental sciences, and of guiding those who desire, in the mean time, or in future years, to reach this standard of preparation by self-instruction or otherwise, the following syllabus of a course of elementary mathematics is added. Such a course would take the student as far as the calculus, and would enable him to understand all lectures upon mechanics, statics, and dynamics, and make use of the generality of text books upon those subjects. Before entering upon the course of study the student would derive great advantage from the reading of some work on logic of the character of the "System of Logic," by J. S. Mill, or Thompson's "Laws of Thought."

Syllabus of a Course of Elementary Mathematics, preparatory to the Study of the Physical and Natural Sciences, and of their application to Industry.

Arithmetic.—Numeration and notation. *Integral Numbers:*—The four principal operations of arithmetic with whole numbers (addition, subtraction, multiplication, and division). Determination of the greatest common divisor of two or more numbers, and the simplest common multiple. *Fractions:*—1° *Vulgar Fractions*—Formation of vulgar fractions; the four principal operations with them. 2° *Decimal Fractions*—Distinction between vulgar and decimal fractions; the four principal operations with decimal fractions; conversion of vulgar fractions into decimal fractions, and the reverse.

Extraction of roots.

Ratio and proportion.

Geometry.—1° *Plane Geometry*—Properties of lines and angles. Properties of triangles and quadrilateral figures. Ratios and proportions. Geometry of the circle, and the measure of angles. Regular polygons, and the measure of the circle.

2° *Solid Geometry.*—Intersection of planes—solid angles. Solids bounded by planes:—The parallelopiped; polyhedrons. The three round bodies:—The cylinder, cone, and sphere. Properties of the sphere and spherical triangles.

Or the whole of Euclid's Elements of Geometry.

Elements of Geometrical Analysis.

Algebra.—The four rules with monomes and polynomes. Simple powers and roots. The greatest common measure, and the least common multiple. Fractions.

Equations of the first degree, including one unknown quantity. Equations of the first degree, including two or more unknown quantities.

Arithmetical progression. Geometrical progression. Permutations and combinations. Series and indeterminate coefficients. Binomial theorem.

Equations of the second degree. Exponential equations. Exponential and logarithmic series. Use of logarithms.

Classification of algebraical expressions and consequences.

Relation between number and magnitude.

Trigonometry.—Definitions. Relations of trigonometrical lines. Relation between sines, cosines, &c., of sums, and differences of angles. Solution of plane triangles.

Elements of Analytical Geometry.—Application of algebra to the theory of Curves:—Straight lines; transformation of co-ordinates; lines of the second order, or the conic sections. Application of algebra to the theory of Surfaces:—The straight line in space. The plane. The sphere, cylinder, and cone. Surfaces of revolution. Surfaces of the second order.

Descriptive Geometry.—Projection of lines, of planes, and of curved surfaces. Intersections of lines, planes, and surfaces. Applications to cylindrical, conical, and spherical surfaces. Skew surfaces. Theory of ordinary perspective and of isometrical perspective. Theory of shadows.

R. K.

DUBLIN: Printed by ALEXANDER THOM, 87 & 88, Abbey-street,
For Her Majesty's Stationery Office.

12

Science and Art Department

OF THE

COMMITTEE OF COUNCIL ON EDUCATION,

INDUSTRIAL MUSEUM OF IRELAND.

INVENTORY CATALOGUE

OF THE

SPECIMENS ILLUSTRATING THE MATERIALS, PROCESSES, AND PRODUCTS OF THE MANUFACTURES OF

EARTHENWARE, PORCELAIN, GLASS, AND ENAMELS,

IN THE

COLLECTION

OF THE

INDUSTRIAL MUSEUM OF IRELAND, DUBLIN.

DUBLIN:
PRINTED BY ALEXANDER THOM, 87 & 88, ABBEY-STREET,
FOR HER MAJESTY'S STATIONERY OFFICE.

1866.

GENERAL CLASSIFICATION.

[*These Collections occupy the Eastern Hall of the Lower North Gallery of the Museum of Irish Industry.*]

N.B.—Chaffers' List of Porcelain Marks and Monograms is hung in the Gallery for reference by Visitors.

COLLECTION

OF

MATERIALS EMPLOYED AND EARTHENWARE

MANUFACTURED IN IRELAND.

ILLUSTRATIONS of EARTHENWARE at present Manufactured in Ireland, or with Irish Materials.

Number.

1 to 4. Set of washstand wares, basin, jug, soap and brush boxes, made from the fine white clay obtained at Cahir, county Tipperary.

5. Slip clay for mixing with calcined lead ore or manganese, for glazing common pottery, from Carrigaline, near Cork.

6 to 14. Specimens of the earthenware for common use, made at the North Abbey Pottery, Cork: crock, candlestick, pitcher, tile, and flower-pots, together with the clay employed.

15 to 21. Bricks, flower-pots, and tiles, made at Courtown, county Wexford, from the clay of that locality.

22 to 44. Series of illustrations of the clays found in the mountains near Florence-court, county Fermanagh, and of the varieties of ware made therefrom. From the ordinary clay (No. 25), draining tiles, bricks, crocks, and flower-pots. From finer clay (kaolin, No. 27), Rockingham ware teapots, candlesticks, crocks, and pans.

45 to 57. Series of specimens of fine siliceous clay, obtained at Rostellan, in Cork Harbour, and the plates and tea-pots made therefrom (in Staffordshire).

58 to 73. Series of specimens illustrating the varieties of clays found at Larne, county Antrim, and of the buff and yellow ware manufactured therefrom at that place. Teacups and saucers, bowls, water jugs, and basins.

74 to 81. Series of large draining and sewer pipes manufactured at Courtown, Tipperary.

82 to 85. Specimens of flooring tiles and draining pipes manufactured at Tipperary, county Tipperary.

86 to 100. Series of specimens illustrating the manufacture of tobacco pipes as carried on in Dublin. The pipe-clay, the implements used, and the varieties of pipes made for common use in Ireland.

101 to 102. Two vases of classical form made at Florence-court, county Fermanagh, presented by the Right Honorable the Earl of Enniskillen.

COLLECTION OF SPECIMENS

ILLUSTRATIVE OF

THE MANUFACTURE OF POTTERY,

AS CARRIED ON IN STAFFORDSHIRE.*

EARTHENWARE AND STONEWARES.

A.—MATERIALS.

RAW AND IN THE FIRST STAGES OF PREPARATION.

Number.

1. Boulder flint.
2. Gravesend flint.
3. Calcined flint.
3A. „ „ stamped, or pounded down to be ground on the "pan."
3B. Flint knockings. The impurities (iron-stained pieces) picked out from the flint after it is stamped.
4. Flint ground, levigated and dried.
51. One pint of slop flint at the right specific gravity, 33 oz. to the pint, that being market weight.
5. Felspar, raw, Swedish.
6. „ fired, in the Bisquit oven.
7. „ calcined, in the Gloss oven (American felspar).
8. „ fired in the highest Bisquit oven heat, on the top of the bags or chimneys.
9. „ ground, dried.
10. Cornwall stone, soft, raw.
11. „ „ hard, „
12. „ „ soft, fired in the Bisquit oven.
13. „ „ hard, „ „
14. Hard and soft stone mixed, as used in the ware and glaze, being ground and levigated.
15. Same (14), fired in the Bisquit oven.
16. Hard stone, fired in the highest Bisquit oven temperature.
17. Soft stone, „ „ „
52. Mixed stone from the Ark, at the right market weight of 33 oz. to pint
18. Cornwall clay, or china clay, as we receive it.
19. „ „ fired in the Bisquit oven.
20. „ „ „ highest Bisquit oven temperature.

* This collection was formed by the kind assistance of Mr. Wedgewood, of Etruria, Staffordshire, to whose family are due the greatest improvements in that manufacture in England.

Number.

20A. Cornwall clay, as it is dug up, before being washed.
20B. " " washed, and prepared for sale.

20A. and 20B. from Cornwall as they are.

54. " " at the specific gravity used in the slip house.
21. Ball, or blue clay, raw.
22. " fired in Bisquit oven.
23. " " highest Bisquit oven temperature.
53. Ball clay at the specific gravity used in the slip house.
27. Gray marl, raw.
28. " fired in the Bisquit oven.
28A. A fossil, Sigillaria, fired, from the same marl.
29. Another sort of gray marl.
29A. Same, fired in the Bisquit oven.
30. Red marl.
31. " fired in the Bisquit oven.
32. Black marl.
33. " fired in the Bisquit oven.
34. Saggar clay, composed of all these marls in various proportions.
35. Chertstone, for grinding the materials. A siliceous limestone.
36. Alabaster, from Derbyshire.
37. Plaster of Paris, fine, used for the moulds for figures and other fine work.
38. " " coarse, for all common ware moulds, flat and hollow ware pressers' moulds.
39. Limestone.
40. " ground ready for use, and called "Paris white."
41. Carbonate of barytes, raw, called "waterspar," from Derbyshire.
41A. " " waterspar calcined.
42A. " " ground ready for use.
42. Sulphate of barytes, called "cawk."

42A. is a ground powder. 42 crystalline lamina.

Materials bought Prepared.

43. Flint glass, or callet, used in Parian.
44. Oxide of zinc.
45. White lead.
46. Red lead.
47. Borax.
48. Boracic acid.
49. Borate of lime (this is not prepared).
50. Tincal, East India.

B.—MIXED BODIES.

Number.

54A. China body, dried, from Mr. Minton's.
54B. „ one pint of slop, at the right weight.
54C. Ironstone China body, dried, from Mr. Minton's.
54D. „ „ one pint of slop.
55. Pearl earthenware, one pint of slop.
56. „ „ dried and broken down.
57. „ „ a small slab, fired, and part glazed.
58. Cream colour earthenware, one pint of slop.
59. „ „ „ dried.
60. „ „ „ slab, fired, and part glazed.
61. Drab „ „ one pint of slop.
62. „ „ „ dried.
63. „ „ „ slab, fired, and part glazed.
64. Sage „ „ one pint of slop.
65. „ „ „ dried.
66. „ „ „ slab, fired, and part glazed.
67. Lavender „ „ one pint of slop.
68. „ „ „ dried.
69. „ „ „ slab, fired, and part glazed.
70. Red body, one pint of slop.
71. „ dried and broken down.
72. „ slab, fired.
73. Black basalt, one pint of slop.
74. „ dried.
75. „ slab, fired.
76. Orange (porous ware).
77. „ dried.
78. „ a slab, fired, porous.
79. Cane, one pint of slop.
80. „ dried.
81. „ slab, fired.
82. Stoneware, one pint of slop.
83. „ dried.
84. „ slab, fired, and part smeared.
85. Mortar, material, one pint of slop.
86. „ „ dried.
87. „ „ fired.
88. Carrara or Parian, one pint of slop.
89. „ „ dried.
90. „ „ slab, fired.
91. Nickel, raw, for colouring drab.
92. „ calcined.
93. „ one pint of slop, ready for use, at the right weight.

C.—GLAZES.

English China.

Number.

94. Borax,
95. Soda,
96. Cornwall stone,
97. Flint,
98. China clay,
99. Carbonate of lime,
100. White-lead,

Fritted together and add

101. Flint.
102. White-lead.
103. Specimen of the frit used in Minton's China glaze.
104. One pint of slop glaze, from Mr. Minton's.
105. Specimen of the same, dried down.
106. „ „ fired in the Gloss oven.

Ironstone China.

Messrs. Minton use their China glaze for ironstone body. These are the materials ironstone China glaze was made with 30 years ago or more:—

107. Borax.
108. Stone.
109. Flint.
110. Felspar.

Earthenware Frit.

Materials for Earthenware Frit.

111. Tincal,
112. Soda,
113. Stone mixed,
114. China clay,
115. Carbonate lime,

Fritted together in a kiln or reverberatory furnace.

116. Frit mixture for the above frit, before fire.
117. Frit when fired.
118. Frit made with borate of lime instead of tincal,

Pearl Glaze.

Materials for Pearl Ware Glaze.

119. Frit, as above,
120. Stone mixed,
121. Flint,
122. White-lead,

Ground together 4 days; the frit going on the pan the 1st day, the stone and flint the 2nd, and the lead the 4th.

122A. Pearl glaze, one pint of slop, at right dipper's weight.
123. „ „ dried down.
124. „ „ fired in the Gloss oven.

Cream Colour Glaze.

Materials for Cream Colour Glaze.

Number.

125. Frit as above,
126. Stone mixed,
127. Flint,
128. Cornwall clay,
129. White-lead,

Ground together, as the Pearl glaze, the China clay going on with the flint and stone.

130. Cream colour glaze, one pint of slop.
131. „ „ dried.
132. „ „ fired in Gloss oven.

Stoneware Glaze.

(Same as Cream colour.)

Green Glaze.

Materials for Green Glaze.

133. Tincal,
134. Soda,
135. Nitre,
136. Stone,
137. Flint,
138. Carbonate of lime,

Fritted together in the Bisquit oven.

139. Frit as above,
140. White-lead,

Ground together; the frit 3 days, the lead 1 day.

141. Copper shavings.
142. Copper calcined.
143. „ ready for use in Green glaze, one pint of slop.
144. Green glaze, one pint of slop.
145. „ „ dried.
146. „ „ fired in Gloss oven.

Rockingham Glaze.

Materials for Rockingham Glaze.

N.B.—This is a lead Glaze.

147. Stone,
148. Flint,
149. White-lead,

Ground together 8 or 9 hours.

150. Maganese crude.
151. „ calcined.
152. „ one pint of slop.
153. Rockingham glaze, one pint of slop.
154. „ „ dried.
155. „ „ fired in the Gloss oven.

Mocha Ware Glaze.

156. Frits used in Mocha ware glaze.
158. Mocha ware glaze, fired in the Gloss oven.
159. „ „ one pint of slop.

D.—MODELS.

Bisquit Oven Model.

Number.

160. The Dome.
161. The "clammings" or making up of the entrance with ordinary bricks and marl.
162. Trial hole and brick to close it. Through this hole there is an open way to the centre of the oven by means of open saggars, through which the trials are drawn.
163. "Run" or causeway from the placing house to the entrance of the oven.
164. Flooring of quarries, to which are fastened the "bags" or chimneys into the oven. The whole lifts up showing the arrangement of the flues underneath, to the centre of the oven.
165. "Glut" or ash hole. This is made up with bricks towards the end of the firing, and the amount of air regulated by the intervals left between the bricks.
166. "Mouth" or feeding hole, which towards the end of the firing is covered by the covering quarry.
166A. "Covering quarry." Bound round with iron generally to hold it together when cracked by the heat.
167. "Regulator hole." A hole above the arch over the mouth and under that of the oven, which lets air into the back of the fire-place, and is used in regulating the heat of the oven in different parts by closing it with a brick or opening it.

The light colour shows the parts of the oven that are built of fire bricks the dark, those built of common bricks.

Gloss Oven.

169. The "dome." The fire holes in the dome should be over each of the mouths of the oven.
168. Clammings as in Bisquit oven.
168A. Trial hole and brick to close it.
168B. Run or causeway.
168C. Flooring and bags or chimneys.
168D. Glut. Bars are used in the Gloss oven, as the heat is not so great as that of the Bisquit. The part of the opening above the iron bars is made up towards the end of the fire with bricks (168G), placed so as to admit more or less air as required.
168E. Mouth or feeding hole.
168F. "Covering quarry" as in Bisquit oven.
168G. Bricks to make up the glut.

Enamel Kiln.

Number.

170. Enamel kiln.

170A. Interior lining of quarries made to draw out by placing the two first fingers on the label (170A), at the top inside and the thumb outside, lifting up with the fingers and pulling out at the same time. When out the arrangement of the flues is seen running all round the kiln and at the back.

170B. Steps to go into the kiln.

170C. Iron stages on which the ware is piled up.

170D. Earthenware pillars on which the stages are supported one above another.

E.—PROCESSES OF MANUFACTURE.

Flat Ware Pressing.

Plain Ware Plate.

175. Plate mould (Wellington shape).

176. Slab and batter for flattening out bats of clay.

177. Bat of clay laid on the mould, 177A.

178. " " pressed to the mould (178A) with the hand.

179. Profile for the back of the plate.

180. Plate worked with the profile, the first time (mould 170A).

181. " second time with the profile to form the foot and touched in the centre (181A mould).

181B. Ring on which the plates are laid, right way up, on leaving the mould, after drying in the hot air chamber, to be finished at the edges.

182. Plate after leaving the hot air chamber, finished at the back with the horn and polisher, and stamped. As it leaves the mould before the edges are finished (182A mould).

183. Polisher.

184. Round polisher for the centre of the back of the plates.

184A. Pressers' horns.

185. Pressers' sponges.

186. Pressers' leathers (must be kept in water).

187. Leather to finish the edges of ware.

188. Two Wedgewood stamps.

189. Plate finished, the edges having been cut and leathered

Embossed Ware.

Leafage Comport.

(181c. to I., should be 189A. to G.)

189A. Bat of clay laid on the mould (I).

189B. Batted on to the mould with a sponge.

189C. Superfluous clay round the edges, pressed off with the finger and back leathered.

Number.

189D. Comport finished at the back, except the foot.

189E. Foot put on finished, dried in the hot air chamber, polished with horn and polisher.

189F. Taken off the mould, edges pared and rounded and finished.

189G. Mould for leafage compotier.

Jigger made Ware.

Inside Cups—Czar Shape.

N.B.—A bat of clay, as 177, is laid on the flannel on the mould, 190, and so pressed down to the shape of the cup, the flannel and clay is then taken off the mould, inverted and placed in the mould, 191, the flannel withdrawn, and the clay worked to the mould with the hand and profile.

190. Mould and woollen cap for shaping the bat of clay.
191. Mould for inside cups used on a jigger.
192. Bat of clay pressed to the mould with the fingers.
193. (Inside) profile.
194. 192, after working with the profile.
195. 194, after drying in the hot air chamber is polished, stamped, taken off the mould and finished at the edges.
196. Cup, handled and finished.

Outside Cups—Plain Lahore Shape.

197. Mould for outside cups.
198. Bat of clay, pressed on to the mould with the hand.
199. Outside profile.
200. Cup, 198, worked with the profile, 199, forms the foot.
201. „ 200, after leaving the hot air chamber, is finished outside with the horn and profile, stamped, taken off the mould, and the edges finished off.
202. „ 201, handled.

Hollow Pressed Ware.

Buccleugh Ewer—Plain Ware.

203. Moulds for a pressed ewer.
204. Bat of clay, batted into the mould with a wet sponge.
205. 204, pressed and rubbed with the leather (186).
206. Bottom of ewer.
207. The three parts, 204, 205, and 206, put together, pressed, the seams made good with the leather and a band of clay, dried in hot air chamber, and taken from moulds.
208. Same finished, ready for handling.
209. Handle to the same.
210. Buccleugh ewer finished.

Embossed Ware—Teapot, 110.

Number.

211. Teapot moulds—A, the body; B, the cover; C, the knob; D, the spout; E, the handle.
212. Clay pressed into 211 A, before joining together.
213A. Spout,
214. Handle,
214A. Grid and knob, } As they leave the moulds.
215. Cover,
216. Teapot body and parts, finished before putting together.
216A. Teapot finished.

Thrown and Turned Ware.

Water Ewer.

217. Ewer in first stage of throwing, worked with the hand only.
218. Profile to shape the belly inside.
219. Ewer after the use of the profile, as it leaves the thrower.
220. Wire to cut it off the wheel.
221. Ewer turned.
222. No. 221, cut with a knife, and lip shaped.
223. No. 222, edges finished with a tool and leather (187).
224. No. 223, finished and handled.
225. Handle to water ewer, for mould see No. 253.

Coffee-pot, 129.

224A. Coffee-pot in first stage of throwing, } Worked by hand
224B. „ in second „ } only.
224C. Profile to shape the belly inside.
224D. 224B. after the use of the profile, as it leaves the thrower.
224E. Coffee-pot lid in first stage of throwing.
224F. „ „ in second „
224G. „ „ in third „
224H. „ „ in fourth „
224I. Profile to shape the inside of the lid.
224J. No. 224H. as it leaves the thrower, after the use of the profile.
224K. Coffee-pot body, 224D. in first stage of turning.
224L. „ „ in second „
224M. „ „ in third „
224N. „ „ finished.
224O. „ lid, 224J. in first stage of turning.
224P. „ „ in second „
224Q. „ „ in third „
224R. „ „ finished.

Handling.

228. Tureen handle, moulds.
228A. Clay shaped before putting into the moulds.

Number.
229. Tureen handle, as it leaves the moulds.
229A. „ spare edges broken off.
230. „ seams pared down, handle finished.
230A. Soup-tureen handle of another sort.
231. Sponge tray handle, moulds.
231A. „ „ before putting into the moulds.
232. „ „ as it leaves the mould.
233. „ „ spare edges broken off.
234. „ „ finished.
235. Rose ear for tureen moulds.
237. „ „ finished.
238. Low teacup handle, moulds.
238A. „ „ before putting into the moulds.
239. „ „ as it leaves the moulds.
239A. „ „ spare edges broken off.
240. „ „ finished.
241. Grecian teacup handle, moulds.
244. Czar breakfast cup handle, moulds.
244A., 245, 245A., and 246, the handle in corresponding stages to 238A. to 240.
247. Venetian teacup handle, moulds.
248. „ „ in process of manufacture.
249. „ „ finished.
250. Egyptian teapot handle, moulds.
250A., 251, 251A., and 252, correspond to 238A. to 240.
253. Water ewer handle, mould.
254. „ „ finished. See No. 225.
257. Rushfoot jug handle, mould.
258. „ „ as it leaves the mould.
259. „ „ finished.
260. Mug handle, mould.
260A., 261, 261A., and 262, correspond to 238A. to 240.
263. Bow handle for nursery lamp, moulds.
264. „ „ in process of manufacture.
265. „ „ finished.
266. Bat mould, for making teaspoons.
267. Bat of clay, out of it.
268. Bat mould, for making mustard ladles.
269. Bat of clay, from it.
270. Mould for teaspoons.
271A. Teaspoon, as it leaves the mould.
271B. „ spare edges broken off.
271C. „ finished.
272. Mustard ladle, mould.
272A., B., and C., correspond to 271A., B., and C.
273. Sauce ladle handle, mould.
274. „ „ in process of make.
275. „ „ finished.
276. Nursery lamp spout, moulds.
277. „ „ finished.

Number.
281. Egyptian teapot spout, moulds.
282. „ two halves of spout, before being pressed together.
282A. „ same, pressed together, as they leave the moulds.
283. „ finished.
284. Teapot spout, moulds.
284A. „ bat of clay cut ready to lay in the mould.
284B. „ same, pressed into the moulds.
285. „ two halves pressed together, and seams made good inside with the finger, as they leave the moulds.
286. „ finished.
287. Plume knob, moulds.
287A. „ clay shaped, before putting into moulds.
288. „ bottom pressed.
289. „ bottom and top pressed as it leaves the mould.
290. „ spare edges broken off.
291. „ finished.
292. Rose knob, moulds.
293. „ as it leaves the moulds.
293A. „ spare edges broken off.
294. „ finished.
294A. Sauce tureen, cauliflower knob.
294B. Sauce tureen, knob.
295. Jug snip, mould.
296. „ as it leaves the mould.
297. „ finished.
298. Grate for teapot, mould.
299. „ „ as it leaves the mould.
300. „ „ finished.
300A. Chamber handle.
300B. „ „ bent and finished.

F.—FIRING BISQUIT AND GLOSS OVENS.

301. Saggar, full sized, one side cut away, to show the inside.
302. Plates. A handful of sand is passed round the rims of the plates, to fill up the insterstices between the edges of the plates, and they are placed on some sand at the bottom of the saggar.
303. Sauce tureen, to stand as it is wrapped up on the top of the plates (which should be sprinkled with sand first).
304. Various small articles to go round the foot of the sauce tureen.
305. Paper of sand for the same, which has been fired.
306. Model saggars, to the same scale as the oven models, *i.e.*, $1\frac{1}{2}$ inch to the foot, round, oval, and oblong.

Number.

306A. Model rings to the same scale; bricks also to the same scale, to build up the glut holes to the oven models.

306B. Trials, placed in the centre of the oven, and drawn out at intervals, as the firing up is coming to a close; that is, until, by the colour of the black pieces of clay, the oven man judges that the ware is fired up.

306C. Pyrometer bits and pieces of stone, placed in different parts of the oven, and withdrawn with the ware.

306D. Pyrometer bits of a very well fired oven.

Bisquit Ware.

307. Plate,
308. Czar cup,
309. Plain Lahore cup, } All Bisquit.
310. Buccleugh ewer,
311. Water ewer,
312. Soft brush, to brush the dust off the ware, } Before
313. Hard brush, to brush the sand off the ware, } dipping.

Dipped Ware.

314. Plate, dipped.
315. Czar cup, dipped.
316. Plain Lahore cup, dipped.
317. Buccleugh ewer, dipped.
318. Water ewer, dipped.
320. Bone for washing Gloss oven saggars.

Glazed Ware.

321. Plate, glazed.
322. Czar cup, glazed.
323. Plain Lahore cup, glazed.
324. Buccleugh ewer, glazed.
325. Water ewer, glazed.
327. Full sized Gloss oven saggar.
328. Plates, to be hung on pins, at the top of the saggar.
329. Teapot, and other pieces, to be placed on sharp sides on the bottom; ladle is reared up against the side.

Gloss Oven Trials.

329A. Cream colour Gloss oven trial, withdrawn during the firing, to judge by the colour of the glazed pieces when the oven is "fired up."

329B. Pyrometer bits, placed with the ware, and withdrawn with it.

329C. Same, of a well fired cream colour Gloss oven.

Pyrometer Bits.

Number.

329D. Pyrometer bits, made of Cornwall clay, before fire.
329E. Same, gauged and marked, ready to go into the oven.
330. Packet of sharp sides and pins, to be used in placing the ware, 328 and 329, in the saggar, 327.

Supports in Gloss Oven.

331. Pins for supporting large dishes.
332. Pins of different sizes, to be placed in the holes in the sides of the saggar, to support plates.

333. Stilts, round or ring shaped, 334. „ square, 334A. „ three-legged, 335. „ patent triangular, 336. Sharp sides,	For supporting all ware that cannot be hung and is not very large.

336A. Chipping tool, for knocking off the irregularities caused by the supports, at the point of contact.

G.—PRINTING.

Copper-Plate.

337. Copper-plate, engraved (Moresque pattern).
338. Paper impression.
338A. Plate printed from the same.

N.B.—This plate is more finely engraved than the ordinary run of plates for flowing colours. The dry colours require finer engraving than the flowing colours.

Tools.

339. Knife.
340. Dabber.
341. Boss.
342. Printer's oil, used with the colours.
343. Pottery tissue paper.
344. Same, with various patterns printed on.
345. Transferrer's rubber.

Patterns transferred to the Ware.

346. Neutral, 347. Dark dove, 348. Mulberry, 349. Flowing green, 350. Flowing blue, 351. Puce,	New shaped plates, flowing colours, paper on the ware.
352. Blue, 353. Brown, 354. Black, 355. Pink, 355A. Green,	Old shape plates, quiet colours, paper not washed off.

Papers washed off.

Number.		
356.	Neutral,	Paper, after soaking, washed off the ware with a sponge. New shaped plates, new patterns, and flowing colours.
357.	Dark dove,	
358.	Mulberry,	
359.	Flowing green,	
360.	Flowing blue,	
361.	Puce,	
362.	Common blue,	Paper washed off the ware. Old shapes, old patterns, and quiet colours.
363.	Brown,	
364.	Black,	
365.	Pink,	
366.	Green,	

Printed Ware Gloss Oven Trials.

366A. Trials of printed ware, Gloss oven, drawn out as the oven is firing, to judge by the colour of the glazed pieces when it is fired up.

366B. Pyrometer bits, placed with the ware in different parts, and withdrawn with it.

366C. Pyrometer bits of a well fired oven.

Glazed and Fired Ware.

368.	Neutral,	Plates, flowing colours.
369.	Dark dove,	
370.	Mulberry,	
371.	Flowing green,	
372.	Puce,	
373.	Common blue,	Plates, quiet colours.
374.	Brown,	
375.	Black,	
376.	Pink,	
377.	Green,	
378.	Neutral,	Cups and saucers, flowing colours.
379.	Flowing green,	
380.	Flowing blue,	
381.	Blue,	Cups and saucers, quiet colours.
382.	Brown,	
383.	Black,	
384.	Pink,	
385.	Green,	
386.	Neutral,	Ewers and basins, new and old shapes, flowing colours.
387.	Mulberry,	
388.	Flowing green,	
389.	Flowing blue,	
391.	Blue,	Ewers and basins, new and old shapes, quiet colours.
392.	Brown,	
393.	Black,	
394.	Pink,	
395.	Green,	

Printing Colours.

Number.		
396.	Neutral,	Packets of the colours used in printing, ground and ready for use.
397.	Dark dove,	
398.	Mulberry,	
399.	Flowing green,	
400.	(No. 2.) Blue, both for flowing and quiet,	
401.	Puce,	
402.	Brown,	
403.	Black,	
404.	Pink,	
405.	Green,	

406. Flow used in the oven, placed in saucers in such saggars as the ware is to be flowed in.

Bat Printing.

407. Copper-plate, for bat printing.
408. Glue bat, for the same.
409. Plates bat printed before fire.
410. Same, when fired in enamel kiln.

H.—BASS-RELIEF MAKING.

Tools.

412. Earthenware mould, for forming the bass-relief.
413. Knife to scrape off the superfluous clay.
414. Tool to bring out the clay relief from the mould.

Bass-Reliefs.

415. Portland bass-relief figures before laying on the vase. (These had to be fired to hold together.)
416. Portland vase, part finished, some of the figures laid on.

Ornamental Ware Oven Trials.

416A. &c, Trials, placed in the jasper, and red and black basalt oven, or, as we call it, the ornamental ware oven, and withdrawn during the fire, to judge by the colour of the pieces of black and blue, when the oven is fired up. The pieces of stone and pyrometer bits are only added for curiosity.

164A, B, C, D. Black basalt trials, stone and pyrometer bits.

164E, F, G, H, and I. Blue jasper trials, stone and pyrometer bits.

I.—ENAMELLING.

Ground-Laying.

Number.

417. Oil mixture for ground-laying.
418. Colour dust, Dover green.
419. „ morone.
420. „ pink.
421. A pounce, pierced paper for tracing a pattern.
423. Plates, ground-laid, not fired, morone.
424. „ „ „ Dover green.
425. „ „ „ pink.
426 to 428. Same, fired, but not finished.
429 to 431. Same, finished.

Gilding.

432. Gilding mixture.
432A. Same, ground with oil, ready for use.
433. Pencils, used in gilding and enamelling.
434. Pallet knives, „ „
435. Gilt plate, not fired (Moresque gilt).
436. „ as it leaves the kiln.
437. „ scoured with sand paper.
438. „ burnished.
439. Sand paper, for scouring.
440. Sand, for the same.
441. Burnishing tools, bloodstone.
442. „ „ agate.

Enamelling.

443. Enamelled (printed Nankin) plate, not fired,
444. Same, under fired.
445. „ rightly fired, or fired up.
446. „ over fired.
447. Plain lines, laid on on a horizontal wheel or whirler, not fired.
448. Same, fired.
449. Old-fashioned enamelled pattern, not fired.
450. Same, fired.
451. Another of the same, not fired.
452. Same, fired.
453. Putty powder, for cleaning the burnishing tools on a piece of leather.
454. Flux used with enamel colours.
454A. Same, ground.
456. Chinese enamelled flowers on vase not fired.
457. „ „ „ after first fire.
458. „ „ „ finished.
459. Rings and stilts used in the enamel kiln.
463. Enamel kiln trials, one short fired.
„ „ „ one fired up.
„ „ „ one over fired.

J.—PRODUCTS OF MANUFACTURE.

Stoneware, White.

White Ornamented.

Number.

465. White stone, club jug, not smeared.
466. " acanthus jug, smeared.
467. " teapot, 152, smeared.
468. " and blue rose border in relief, smeared, teapot, 43.

Chemical.

469. Best body, evaporating pan, glazed.
470. Common body, evaporating pan, not glazed.

Mortar.

471. Mortar material, mortar and pestle.

Jasper.

472. White jasper slab.

Coloured Stoneware.

Blue Jasper.

473. Blue jasper and white bass-relief figures.
474. " " " " Maltese jug.
474A. " " light blue and white bass-reliefs.
475. " " and white lines, T P box.

Black Jasper.

476. Black jasper and white bass-reliefs, spill case.
477. " " " " vase, 117.

Sage Jasper.

478. Sage jasper and white bass-reliefs, small piece.

Yellow Jasper.

479. Yellow jasper and blue bass-reliefs, small piece.

Lilac Jasper.

480. Lilac jasper and white bass-reliefs, small piece.

Drab Stone.

481. Drab stoneware, Bacchanalian jug.
482. " " white bass-relief rose border teapot.
483. " " white and lilac honeysuckle teapot.
484. " " " " " sugar.
485. " " " " " cream.

Cane Stone.

Number.

486. Cane stoneware, teapot (24), 43 shape, smeared.
487. „ „ coffee-pot, amoy.
488. „ „ honey-pot, beehive.

FINE NON-POROUS EARTHENWARE.

Black Basalt.

490. Black basalt, plain vase.
491. „ „ black bass-reliefs, large vase, 998.
492. „ „ red bass-reliefs candlestick.
493. „ „ red enamelled Etruscan figures.
494. „ „ teapot, 66.

Red Ware.

495. Red body, Cambridge ale jug.
496. „ „ Pompeian jug.
497. „ „ black bass-reliefs festoons, large vase.

EARTHENWARE.

Cream Colour.

520. Cream colour bisque, round Etruscan soup tureen.
521. „ „ „ twig basket.
522. „ „ „ cushion coverdish.
523. „ „ glazed round Etruscan soup tureen.
524. „ „ „ basket and stand, 1,006.
525. „ „ „ cushion coverdish.
526. „ „ „ twig basket and stand.

Pearl and Best Body.

527. Best body bisque, oval soup tureen, 12.
528. „ „ „ plate.
528A. „ „ „ bowl.
529. Pearl bisque coverdish, Tamworth.
530. „ „ centre, 919.
531. „ „ sauce tureen and stand.
532. „ glazed coverdish, Tamworth.
533. „ „ sauce tureen and stand.
534. „ „ square Brabant compotier.
535. Best body, printed, oval soup tureen, 12.
536. „ „ plate.
537. „ „ bowl.
538. Pearl, „ coverdish, Tamworth, blue water nymph.
539. „ „ basket and stand, 1,006.
540. „ „ centre, 919.
541. „ „ and enamelled punchbowl.
542. „ ground-laid ewer and basin.

Coloured Glazes.

Green Glaze.

Number.	
543.	Cream colour bisque, centre, B.
544.	" " compotiers, N. and No. 2.
545.	" " plates, O. and No. 7.
546.	Green glaze, centre. B.
547.	" compotiers, N. and No. 2.
548.	" plates, O. and No. 7.

Rockingham.

549. Cream colour bisque, teapot, 129.
550. " " " Clarendon.
551. Rockingham glaze, teapot, 129.
552. " " " Clarendon.

Coloured Earthenware Bodies.

Lavender.

553. Lavender bisquit, pillar candlestick.
554. " " teapot, czar.
555. " glazed, pillar candlestick.
556. " teapot, czar.

Sage.

557. Sage bisquit, flat candlestick, and extinguisher.
558. " " cup and saucer, white inside.
559. " glazed, flat candlestick, and extinguisher.
560. " " cup and saucer, white inside.

Cane.

561. Cane bisque, teapot, 159.
562. " " game pie (is not glazed).
563. " glazed, teapot, 159.
564. " " club jug.

Drab.

565. Drab bisque, Dutch jug.
566. " " bowl, white inside.
567. " glazed, coffee biggin.
568. " " bowl, white inside.

Porous Ware.

569. Orange porous, wine cooler.
570. Black " water bottle.
571. Cane " daisy butter tub.
572. Orange " battery cell, and mortar one to fit it.

Crucible.

573. Coarse crucible.
574. Fine crucible.

K.—PARIAN MANUFACTURE.

Parian.

(This should come in, all except the last item, after 416I.)

Number.

580. Moulds for the figure of the Nymph at the Well.
581. Leg, after the first fire.
582. Stand and foot as they leave the mould.
583. Hand and arm, the seams taken off and worked down, finished, except the last touches, such as marking the nails, &c.
584. Hand and arm, with the shell finished, as it leaves the oven after the second fire.
585. Body and head, finished, fired twice, as the last, but rubbed with pumice stone, and scoured.
586. Figure of "Nymph at the Fount," complete.

L.—IRONSTONE CHINA SPECIMENS.

Ironstone China.

587. Bisquit plate, ironstone china, from Messrs. Minton.
588. Ironstone china, glazed (English soft china glaze).
589. " " printed pattern for filling in.
590. " " ground-laid.
591. " " gilt.
592. " " printed and enamelled.
593. " " painted.

N.B.—Nos. 591 and 593 are more expensively got up than is usual with ironstone china.

M.—MOCHA WARE.

Mocha.

594. Mocha ware, as it leaves the thrower.
595. " turned.
596. " glazed.
597. " turned, and the colours in the shape of slip dabbed on with a sponge, and with the end of the finger, fired, Bisquit oven.
598. " same, glazed.
599. " turned, and the colour in the shape of slip run on to the ware through a quill, while it is on the lathe, fired.
600. " same, glazed.

MISCELLANEOUS COLLECTIONS,

ILLUSTRATING

THE EARTHENWARE MANUFACTURES

OF

GREAT BRITAIN.

MISCELLANEOUS MODERN ENGLISH PORCELAIN AND POTTERY.

Number.

1. Large blue and gold vase, with four medallions painted on sides in colours; flowers and Cupids. An imitation of Louis XV. style of Sevres porcelain. Presented by Mr. Daniell, London.
2. Fine black enamel jug, with arabesque ornaments *en grisaille*, with grotesque animal heads. Style—Renaissance.
3. Fine two-handled jar, by Minton; imitation of the fine faience of Nevers, temp. Henry II.; ground blue, with figures and garlands in pale blue and white, buff lines, and serpent handles.
4. Vase for flowers; Celadon green ground, wreaths of fruits—raspberries and currants, with butterflies.
5. Flower vase, white, blue bands, wreaths of ivy, and pendant bunches of birds, hares, arms, and implements of the chase.
6. Large game pie-dish, basket work, with oak branches and leaves; cover, with dead game in colours in high relief.—Minton.
7. Card basket, white, with gold and pink shell bottom, green open-work flowers in colours in high relief.—Colebrookdale Pottery.

*7. Head of Duke of Wellington, in Parian ware; by Copeland.

8. Head of William Dargan, in felspathic Parian ware.—By Kerr, Worcester and Dublin.
9. Flower vase in coloured Parian ware.—Copeland.

10, 11. Jug and basin, small toilet ware, soft porcelain, white, with bunches of rosebuds and squares of polygala sprigs.

12. Teapot, yellow body, with green water-plants in relief; top, with mushroom handle in high relief, coloured.
13. Dinner plate, red on white ground, with purple and gold, red flowers; centre, printed black tree, with ribbon and inscription—"Royal Arcade Hotel."—By Brown.

Number.

14. Supper plate, crimson rim, with bunches of flowers in colours on white ground; centre, white, with star, scroll ornaments in purple and gold.—By Brown, London.

15 to 18. Sauce-boat, with attached tray, and three plates, white ground, flowers and shrubs with birds in colours, and gold Chinese style decorations.—By Donovan, China Works, City-quay, Dublin, about 1815.

19. Flower vase, soft red earthenware, lustre glaze, imitation of antique Samian (Roman) ware.

20. Buff earthenware jug.

21. Small brown jug, salt glaze.

22, 23. Coffee breakfast cups, French pattern, in biscuit and glazed.—By Kerr, Worcester and Dublin.

24. Black salt-glazed earthenware pickle jar.

25. Money jar, buff earthenware, glazed.

26. Tea-cup and saucer, in bisquit.

27. Flower vase, wide mouth, stone colour, with twining foliage, in platinum glaze.

28. Sauce tureen, stand, and ladle; ironstone china; printed in purple, with landscape pattern; mark, a phœnix. Tillenberg—J. Clementson.

29. Ornamental flower pot, brown ground, ironstone ware, green leaves, wreathing in high relief.—Presented by Mr. Bell.

30. Cup and saucer, delft, semichina, white and blue willow leaf pattern.

31. Water ewer, white and gold.

32. Jug, Parian stone ware, crimson body, with white ornaments in high relief; boys climbing trees and robbing birds' nests; by James S. Moyse.—Presented by Mr. Taylor.

33. Sugar bowl, brown Staffordshire ware, embossed moulded pattern.

34. Small plate, white delft ware, with printed design of Royal Exchange (Town Hall), Cork-hill, Dublin, in red; made at the Pottery in Potters'-alley, Marlborough-street, Dublin. Date about 1810.

35. Set bisquit scent jar, yellow ware.

Series of Decorative Tiles and Slates.

1, 2. Specimens of decorative tiles for mosaic tesselated pavements, prepared by Minton's patent process of dry compression.

3, 4. Two large framed squares of Minton's compressed tiles arranged, showing mosaic pattern.

Large illustrations of those tiles will be seen in the tesselated pavements, on floor and at the centre window, of the Lower Cross Gallery, immediately opposite the entrance door.

Number.

5 to 15. Series of printed Dutch (delft) tiles used for lining fireplaces and coating stores and rooms.

16 to 57. Series of ornamental tiles for flooring and mural decoration, embossed and inlaid patterns, enamelled and gilt, from Messrs. Minton's Works, Staffordshire.

Miscellaneous Collection of Terra Cottas, Fire-clay, and other coarse Earthenwares.

(*Foreign and British*).

1, 2. Large glazed sewage pipe.

3. Refrigeratory, or wormpipe for distilling.

4. Large ellipsoidal vase on pedestal, with design in relief of classical nuptial procession.

The above, 1 to 4, from Messrs. Ferguson, Miller, and Co., Glasgow.

5. Large sewage pipes.

6, 7. Ornamental chimney pots.

8. Balustrade column.

9. Sundial pillar; highly ornamented with spiral fluting and wreaths of fruit and flowers round base.

The above, in white fire-clay ware, from Messrs. Kenneth and Co., Kilwinnig, Ayrshire, N.B.

10 to 15. Architectural ornaments, consols, and borders.

16. Model of fire-clay oven for baking.

17. Ornamented moulded trencher.

18. Long flower-stand box.

19, 20. Two large classical formed vases with pedestals.

The above, 10 to 20, from Farnley Iron Co., Wortley, Leeds.

21. Large ovate vase, with serpent handles, and medallions representing Winter, &c., white fire-clay ware.

22. Figure of Diana dressing after bath.

23. Figure of Flora, white stoneware.

The above from Mr. Blashfield, Millwall, Poplar.

24. Large vase, in white fire-clay ware, representing the vintage, sports of Cupids, and Bacchanalian procession; from Messrs. Bell and Co., Glasgow.

25, 26. Series of crucibles and melting pots of various kinds and forms; from Messrs. Morgan and Rees, London.

27, 28. Pair of consol flower vases, in red earthenware, with embossed Bacchanalian designs.

29, 30. Consol of female head, supporting statuette of Neapolitan peasant girl, carrying water pitcher on head in yellow terra cotta.

31 to 36. Architectural ornaments, consols, borders, and tablets.

37, 38. Flower-stands for suspension, in red and yellow terra cotta.

Number.

39. Ornamental fountain, with upper and lower dishes, highly decorated in red terra cotta.
40. Byzantine capital with foliage.
41, 42. Ornamental tablets, perforated in foliage, for architectural decoration, fire-stone ware.
43, 44. Large figures, life size, of the Muses, Polyhymnia and Urania, in red terra cotta.

The above, 27 to 44, from the Berlin Terra Cotta and Pottery Works.

45. Byzantine capital in grotesque foliage.
46. Ornamental pillar capital in florid Italian style.
47. Large consol, acanthus-leaved pattern.
48, 49. Pair of vases of classical design, without handles.

The above, in fire-stone ware, from M. Marsch, Charlottenburg Potteries, near Berlin.

50, 51. Two large figures, in cream stoneware, representing the seasons, Summer and Autumn, from the original statues by Professor Leeb, Munich.

HISTORICAL COLLECTION

OF

ANCIENT AND MODERN

EARTHENWARE AND STONEWARE.

ANCIENT POTTERY.

A.—HIBERNICO-CELTIC.

Number.

1. Bones found in cinerary urns in Ireland, from collection of Mr. Huband Smith.
2. Nine fragments of very large cinerary urn containing bones, roughly decorated with tool-marks in irregular herring-bone design.
3. Small cinerary urn, with rude geometrical scratched pattern border, containing bones and calcined flintstone.
4. Very small cup, rudely fashioned in clay, with scratched geometrical border pattern, imperfectly burned.
5. Fragment of cinerary urn.
6. Small cinerary urn in red clay, found in the Moat of Lamanstown, near Dunlavin, county Wicklow, by Frederick De la Poer Trench, esq., on the property of the Baron de Robeck. This urn is much more elaborately decorated than any of the preceding, the pattern being evidently formed by pressure from a mould tool. The design is round dots in square and rhomboidal spaces, separated by smooth bands. A wave pattern scroll border near top, and rudely formed stars near base.

7 to 23. Series of pavement tiles found in ancient Irish abbeys and churches—principally Christ Church, Dublin, Mellifont Abbey, and Bective Abbey, county Meath. Of the three varieties, those with depressed patterns and the encaustic tiles probably belong to the thirteenth or fourteenth century, but those with raised patterns to a later and corrupt period of art, probably about the sixteenth century.

ROMAN AND ITALO-GRECIAN.

7. Cinerary urn, very perfect; fawn-coloured, with handles; plain, but two fine horizontal lines round body at handles. Roman British, purchased from Mr. Chaffers, Bond-street.

Number.

8. Small two-handled cup, Roman British, edge broken.
9. Small jug, with handle, Roman British.
10. Very small very well-formed vase, with handle, whitish clay; two narrow brown bands round body.
11. Small bottle of red clay, used probably for perfume or spice. Such were termed lachrymatories.
12. Small jug, in red clay, with elevated handle. Mouth squeezed, forming triple lip.
13. Jug with handle, light red ware; aperture compressed, forming triple lip pattern; horizontal bands in dull red glaze.
14. Small bottle-shaped jug; neck perforated by hole for cord, lip with wide round flange; decorated with pattern in brown lines, lustred; horizontal on body, vertical round neck.
15. Very elegant cup with two handles, white material, with well-drawn patterns, in brown lustre, of duck, buffalo, and tiger, with border of vertical lines.
16. Small cup, with two handles, in white ware; pattern in brown lustre, not well preserved; horizontal bands.
17. Cup, with two handles; similar to 16, but smaller pattern, better preserved, brown lustre.
18. Small bottle-shaped vase, with handle, red ware; pattern, black lustre; bands on neck and base, network oblique lines on body.
19. Cup, with two handles, same ware and character as 16; pattern, bands on top and vertical lines round base very much obliterated.
20. Tall, nearly cylindrical cup, in fine pale red ware; body with fine white glaze and faint brown lines at edge; black lustre, round base, and flat foot.
21. Single-wick lamp in red clay (terra cotta), with embossed ornaments of human figure.
22. Very fine double-wick lamp, with triangular handle perforated with hole for cord; richly decorated with ornaments in relief—female figures at altar or kneading trough, and honeysuckle patterns.
23. Candlestick in red ware; handle, body, and stem in black lustre; the foot white lustre glaze, with traces of a rich scroll, and honeysuckle pattern in black and red lustre.
24. Cylindrical box, with cover very richly decorated with dotted and chequered pattern in bands of brown and red lustre glaze, and moulded edge border in relief.
25. Cover of a box or jar in pale ware, rich pattern, impressed with rod and band of plumbaginous lustre, yellow lines and dots in zigzag.
26. Small round, flat tazza, inferior ware, without ornament.
27. Small wide-mouthed jug, body fluted, black glaze much worn off.

Number.

28. Small narrow-necked jug, round mouth and handle, base flat.
29. Two-handled cup, without ornament, black lustre glaze.
30. Small two-handled vase, simple moulded design, black lustre glaze.
31. Flat tazza, with one handle, no ornament, red body with black lustre glaze.
32. Vase, two-handled; pattern in red basis on black lustred ground; female heads, with honeysuckle design at handles.
33. Similar vase, a little larger; pattern better executed, but more injured.
34. Cup, without handles; pattern, figures recumbent, and sitting, with interposed circles; broken and repaired.
35. Very small jug; neck three-sided, compressed, and broken, black lustre; pattern red, a naked boy and bird.
36. Flat vase, apparently had handle on top, now wanting; pattern, a deer, and monstrous figure with female head, wings, and lion's tail.
37. Small vase, with narrow neck and handle; pattern, red on black lustre ground, robed figure sitting in chair.
38. Small vase, narrow-necked, with handle richly ornamented; design of combat of four figures, two on horseback, in black lustre on red ground; foot, black lustre.
39. Flat cup, in black Nolan ware, so called from the town of Nola, in Campania, said to have been a principal seat of its manufacture. Of its two handles, one has been broken off; base fluted in rays; handle modelled in foliage and dots; inside of cup rudely decorated with figures in intaglio, intended for lions or leopards.
40. Cup in Nolan ware, with one tall moulded handle; simple zigzag scratched border at rim.
41. Goblet or vase of Nolan ware, on foot; zigzag scratch at rim, moulded bands at bottom; pattern on body, moulded in relief, boars, two groups of three, separated by arch; trees scratched; round stalk of base, four draped female heads in high relief; design boldly, but rudely executed.
42. Flat cup, on foot, very hard ware; black lustre, simple rays on edge.
43. Small sepulchral-draped female figure from Nola; whitish material, hollow, five inches high.
44. Caryatis from Athens; draped female figure, five inches high.
45. Small cup of red ware, with bright red glaze, called Samian ware, from having been originally made in the island of Samos. This specimen was found in the foundations of buildings in London; and such were either made in large quantities by the Roman colonists in Gaul and Britain, or were brought from Italy by them; more probably they were made on the spot, as Roman potteries have been found in several places in England.

Number.

46. Very fine bowl, in the red Samian ware, Italian or Romano-British imitation ; broken and repaired ; very richly decorated outside with scrolls in relief and medallions, representing Roman soldiers in various fighting and warlike attitudes. See No. 45.

MODERN AND MEDIÆVAL POTTERY.

A.—BRITISH POTTERY.

1st.—Old Staffordshire Earthenware.

(*Period*, 17*th and* 18*th Centuries.*)

1 to 3. Three pieces broken fragments brown red earthenware, dark lead glaze.

4, 5. Broken two-handled mug, and fragment of hard gray earthenware, with dark brown lead glaze.

6. Fragment of mug of gray ware, with yellow brown lead glaze.

7, 8. Cup and bowl, broken, with handle, yellow lead glaze, with brown ware pattern.

9 to 12. Four fragments of yellow glaze earthenware, with patterns, brown and yellow, in low relief.

13. Small candlestick, yellow ware, lead glaze, pattern brown spots.

14. Small candlestick, white ware, moulded, pattern blue markings, climbing fox.

15. Figure of female with children (Charity), white ware, with colours.

16. Old Staffordshire white earthenware bow pot (for flowers), pattern rude in flowers, with imperfect gilding.

17. Cornucopia, amorino in relief, old English, with blue flowers—Cupid drinking.

18 to 21. Four cruets and pepper-castors in white ware, soft glaze.

22, 23. Two ladles, white ware.

24. Vase on foot, with moulded ornamental foliage, white ware.

25. Old Staffordshire white ware plate, embossed border.

26. White ware plate, border plaited and gilt.

27. Dense white ware oval dish, with openwork border, hard glaze.

28, 29. Rhomboid-oval bowls, border plaited with scrolls, and gilt, white ware.

30. Oval dish in basket-work relief, and openwork border, centre blue cross, dense white ware, hard glaze, early Wedgewood.

Number.

30. (*bis.*) Perforated basket, lozenge pattern, similar ware.
31. Plate, white ware, crest in centre, fish and barrett cap in red and black, border round edge, simple festoon, same colours.
32. Small plate, white ware, border green wreath, with blue edge lines.
33. Small fluted cup, old Staffordshire.
34. Agate ware knife-hilt.
35. Circular teapot, old Staffordshire ware, with birds and flowers in rude colours.
36. Circular teapot, similar ware, with raised moulded ornaments.
37. Cream jug, old English, salt glazed ware.
38. Star-shaped jelly mould, same ware.
39. Spittoon, old English, salt glazed ware.
40. Oval-ribbed jelly mould, same ware.
41. Similar specimen, smaller.
42. Oval dish, rich open basket-work rim, hard glaze, dense ware, edge polygonal and scolloped.
43. Octagonal, old Staffordshire, salt glazed deep plate, lattice border.
44. Tureen cover, oval pointed, rich lattice work, embossed pattern, salt glazed, white hard ware.
45. Circular-shaped compotiere, embossed diaper pattern.
46. Oval compotiere, light white ware, with blue edge, plaited in scrolls, mark Turner.
47, 48. Two small plates, white ware, blue patterns, landscapes, possibly made at Liverpool.
49. Plate, white ware, centre shield with crown and inscription, Oranje Boven motto, Phillips and Co., Sunderland pottery.
50. Small earthenware flower-pot and stand, embossed foliage pattern.
51. Punch-bowl, old Staffordshire brown stone ware, Chinese floral ornaments in relief.
52. Mug with handle, broken, white ware, with royal arms, and lions and foxes in blue relief.
53. Jug with handle, old English, richly embossed earthenware, fancy festoons and choral emblems.
54. Coffee-pot and cover, old English ware, raised scroll-work in green, yellow, and brown enamels.
55. Coffee-pot in black Staffordshire ware, embossed patterns, classical groups and emblems in medallions.
56. Grotesque-shaped animal (dog ?), old Staffordshire.
57. Milk-ewer, salt glazed, embossed pattern, blue tinted, old Staffordshire.
58. Cup and saucer, white ware, embossed, floral group in high relief.
59. Sauce boat, embossed design, animals, birds, beasts, and flowers.

Number.

60. Small bowl and cover, embossed scroll pattern, bird on top.
61. Ladle, leaf embossed (Fenton ?).
62. Small figure, salt glaze, white, man in academic gown.
63. Vase with two handles, embossed, green scroll and leaf moulding, with medallions in blue and gold.
64. Candlestick, Staffordshire, square columns, fluted.
65. Teapot and cover, cauliflower ware, green and white, by Whielden or Fenton.
66. Old salt glazed, Staffordshire, richly embossed teapot, with eight medallions representing fables of Æsop.
67. Teapot, representing monstrous animal (camel) loaded with tower, and lying down ; on tower embossed camels, loaded, and palm trees.
68. Coffee-pot or cream-jug and cover, embossed fancy scrolls, lamb on top as handle.
69. Teapot and cover, embossed, simple flowers and scratch line, lozenge pattern.
70. Bowl and cover, embossed with basket-work, scrolls, and flowers, in colours, blue, green, and brown.
71. Scalloped shell, tortoiseshell ware, Staffordshire.
72. Very fine teapot and cover, in tortoiseshell ware, embossed pattern, vine foliage, bird on cover, scattered gilding.
73. Sugar-bowl and cover, to match preceding specimen 72.
74. Cream-ewer, tortoiseshell ware, flower on cover, green and brown pattern.
75. Small teapot, tortoiseshell ware, green and brown.
76. Plate, tortoiseshell ware, green, yellow, and dark purple, embossed rim.
77. Teapot, small, no cover, tortoiseshell, embossed vines, tendrils, leaves, and grapes, brown.

Lambeth Soft Pottery.

78. Delft pomatum pot.
79. Honey pot.
80. Large teapot, with crown, apple green, with Chinese figures and landscapes in blue, with scroll borders, and serpents on handles.
81. Mug, old English, with arms of Carpenters' Company, square and compasses, and date, 1670, in blue.

Liverpool.

82 to 85. Three plates and dish, part of a toy service, group of figures printed in brown centres on yellow ground, green edges.

Number.

86. Sauce tureen and cover, white, with rich purple borders, and bunches of roses in colours, ornaments roses moulded in relief, Herculaneum pottery.
87. Large mug, yellow ground, large landscape lake, figures and rims in brown red, printed.
88. Teapot and cover, landscapes and groups of figures, fashion Louis XV., printed in black.
89. Plate, centre printed, landscape, classical ruins and figures, sprigs of flowers and fruit on border, brown.
90. Dove seated on its nest, compotiere.
91. Oblong flower-pot, landscape and figure blue.

92, 93. Stoneware jugs. Period of George I. Hard glazed, with blue pattern, moulded and lettered G. R.

Rockingham Ware.

94. Egg cup, brown glaze.

Swansea.

95. Earthenware mug, vine landscape printed in colours, view of Swansea.

Staffordshire Red Ware.

96. Saucer, red ware, ornaments on bottom, musical instruments and sprigs in relief.
97. Small sauce-ladle, red terra cotta ware.
98. A pail-shaped cup, red ware.

Hard Stoneware—Old Wedgewood Ware.

1, 2. Two oval dishes, oldest Queensware, by Wedgewood, cream yellow glaze, black edge-line, centre branch of bittersweet (1), branch of fancy rose and rib-grass (2).

3. Plate, purple edge; crest, eagle, purple; motto, "Multa tuli fecique."
4. Plate, border of musical instruments, centre music and words of "Non nobis Domine," printed in black.
5. Plate, border of gold, with scroll and grapes; crest, goat, in colours.
6. Plate, border red, white, and blue lines, centre head printed in red, Captain Churchill, 1789.
7. Plate; crest, horse's head; motto, "Nil time;" red line on edge.
8. Plate, edge red, and black lines; crest, chained blood-hound, in colours.
9. Saucer, white, with blue flowers.
10. Small plate, edge moulded in lines, yellow cane ware.
11. Plate, yellow cane ware, lined with white enamel.

Number.

12. Oval dish, basket-work pattern in relief, openwork border, blue ground, with rich ornaments in white relief; on base, wreaths and festoons of flowers and honeysuckles; on vase, triumphant Bacchanalian procession of male and female figures; on cover, sprigs and perforations.

13 to 16. Sauce bowl, with circular stand and cover, and two oblong trays of white ware, very richly decorated with flowers and foliage, in colours and gilding.

17, 18. Two small jugs, covered with brown scale pattern, with bunches of flowers in colours and gilding.

19, 20, 21. One large and two smaller vases, ovate, flat-mouthed, red body, glazed white ware, rich flowers, birds, and butterflies in blue and gold, white handles and lip, with blue and gold bands.

22. Small flower or match holder, yellow cane ware, ovate pointed pattern, blue enamel and yellow diamond chequers.

23. Fine bust of Admiral De Ruyter, black jasper ware.

24. Sugar-bowl and cover, black jasper ware, ornaments in red wreaths of flowers in fine relief.

25. Plate, black jasper ware, border rich wreath of flowers moulded in relief, red.

26. Milk jug, black ware, border of scroll lines, in red, and white at rim.

27 to 30. Two candlesticks and two cylinder supports, very rich classical design, panels black, ground separated by foliage and honeysuckle ornaments in relief, with medallion, groups of figures in white representing sacrifices, &c.

31 to 33. One large and two smaller vases, in red ware, classical forms with figures in black lustre, after Etruscan designs, and honeysuckle ornament.

34, 35. Basket and circular stand, blue and white ware, pattern basket-work in relief.

36. Oval bread and butter dish, blue ground, border leaves in white, basket rim in white and blue.

37. Cream jug, blue ground, white leaves round foot, cameo figures of children playing round body.

38, 39. Two hexagonal-shaped small vases, red body, black classical figures and ornaments in relief, modern.

40. Large vase, Etruscan form, black ground, pattern honeysuckle and scroll ornaments in red, modern.

41. Large vase, Etruscan form, red ground, figures in black and white round body, on base and neck classical ornaments in black.

42. Black and red imitation Etruscan two-handled vase, painted with figure of bearded Bacchus, red and white, height $11\frac{1}{2}$ inches.

Number.

43. Black jasper vase and cover, medallion of three female figures in relief; handles, female heads with Egyptian head-dress.
44. Large flower vase, with cover and stand (modern).

MEDIÆVAL ITALIAN EARTHENWARE, TERMED MAJOLICA.

1. Majolica Plateau, coarse ware, with male figure of warrior in plate armour in centre. Portrait.
2. Majolica Plateau in coarse Syrafito ware, with the armorial bearings of the Medici family in the centre.
3. Spezeria vase, or apothecary's jar for holding medicines, with armorial bearings of cross and laurels, with crown in blue and yellow.
4. Jug, with handle, decorated with bunches of leaves and flowers in colours.
5. Majolica oil and vinegar stand, marked olio and axido in dark blue on gray ground.
6. Oviform Majolica drug-pot, with representation in colours of Christ healing the blind.
7. Fragment of enamelled blue and yellow tile. Style, Azulejo of the Arabs.
8. Fine Majolica dish, representing landscape with nymphs changed into trees, with fauns expressing grief. On back—"Loro et Driope nimpe mutate in albori in lor nomi."
9. Majolica plate, two pieces broken from edge. Landscape, with Cupid escaping from a nymph, persons bathing. The colouring of this plate is very fine.
10. Majolica portrait plate, with young female in costume of the fifteenth century, with ribbon, bearing name Bartolomea.
11. Majolica plate, one foot broken. Landscape with figures, representing a satyr approaching a tent, the curtain of which he raises.
12. Majolica plate. Landscape and figures representing triumph of Apollo over Marsyas. Apollo plays on the fiddle to the admiring shepherds, while Marsyas is being flayed and changed into a river. On back—"Il Marsia mutato in fiume."
13. Majolica plate, with recumbent female figure, landscape, and tent.
14. Small plate. Venus breaking Cupid's bow, Cupid in tears. On edge Cupids and heads.
15. Small plate. Countrywoman and child. On edge Cupids and heads.

FRENCH EARTHENWARE.

Faïence.

Number.

16. Old French Faïence barber's shaving dish, probably made at Nevers, illustrating the introduction of the Majolica colours, blue and yellow, into France, with adoption of fine patterns in flowers, instead of the Italian style of portraits and classical scenes.
17. Jug with handle, in Faïence de Nevers, similar style and pattern to No. 16.
18. Bowl in earthenware of Rouen, arabesque style and flowers, coarse.
19.} 20.} Two round dishes of old Rouen earthenware, fluted pattern, fancy design of flowers and arabesques.
21. Teapot or ewer in brown glazed Avignon wares, with ornaments in relief. Heads and architectural foliage, drab and green.
22. Plaque bass-relief, Raphael's Madonna della Sedia, stoneware, with blue-glaze surface, producing shading by depth.

French Enamelled Earthenware—Pallissy Ware.

23. Plaque of enamelled Pallissy ware, representing Esther before King Ahasuerus.
24. Salt-cellar, Pallissy ware, grotesque design. Green frog riding a perch, and bearing a pearly nautilus shell.

OLD FLEMISH, GERMAN, AND DUTCH STONEWARE.

25. Very fine basin, on foot of Flemish yellow ware, with medallion ornaments in relief; centre representing the Lord's Supper, and round inside twelve scenes of the Passion; on the outside, sixteen medallions, representing heads of popes, emperors, and knights, Scriptural subjects, and grotesque masks of animals' heads—about 1550.
26. Jug, brown stoneware, with handle; round body, four compartments, with coats of arms; below, inscription in old Flemish, descriptive of same, with date 1584.
27. Stoneware kannikin, with pewter cover; three medallions in relief, two with figures of Rex Davit holding his harp; in centre, medallion of Judith with head of Holofernes.
28. Stoneware kan, old Flemish yellow ware, very fine. Three oblong medallions in relief; centre figure of warrior with sword and shield, and legend, "Gladius Domini et Gideon." An imperial crown above and below the double-headed eagle; at right hand a similar medallion, with warrior and legend "Josue;" at left hand, a female in dress of period, stabbing herself, legend "Lucretia;" date 1577.

Number.

29. Old German gray stoneware inkstand, with blue glaze; pattern, openwork relief, with birds.
30. Old German Apostle's jug or becker; brown ware and glaze. Figures of the twelve Apostles round body in bold relief and in colours; round bottom edge; legend, "Für Speiss und Trank dem Geber Dank;" date 1706.
31. Small jug, German earthenware; decoration, convolvulus stem and leaves, twining in bold relief.
32. Soap-box, enamel glazed white German ware pattern; foliage and flowers.
33. Vinegar and spice stand, same ware, red sprigs and figures of Indian with fan and Chinese with pipe.
34. Plate, openwork border; on centre, full-blown red rose with leaves.

The above three articles are probably of Frankenthal; 33 and 34 are marked H, and numbered. The red colour used is characteristic.

35. Ornamental form of lady's shoe, in old delft ware; rich blue and white flowers; date and initials, E. R., 1707.
36. Old delft two-handled pot and cover; pattern, fancy flower in red and blue, on white ground.
37. Old delft compotiere, in white and blue, with Chinese interior and figures.
38. Delftware small jug; grotesque baboon sitting on rock, and drinking from small jug forming spout.
39. Old delft heart-shaped pen-and-ink holder; design, flowers and scrolls, white and blue.
40. Very fine large round dish, old delft ware, enamelled in colours. In centre, Venus, with Cupids shooting arrows, and doves on clouds; rich colours and gold; border, scrolls in blue, red, and gold.
41. Large round dish, old enamelled delft ware, companion to No. 40. Centre design, Europa carried off by Jupiter under the form of a bull; landscape, with city and volcanic mountains; peasants and women.

MODERN GERMAN, RUSSIAN AND DUTCH EARTHENWARE.

42. } Two small flower-pots, brown earthenware, modern German.
43. }
44. Small teapot, red earthenware, from Tetschen, Bohemia.
45. Ornamental flower vase, common German brown ware, with gilding.
46. Bowl, blue and white delft ware, made at Riga, Russia; landscape, with water and ships.
47. Plate, delft ware, made at Riga; brown geometrical pattern, with flower centre.

SUNDRY AFRICAN, INDIAN, AMERICAN, AND AUSTRALIAN EARTHENWARE.

Number.

51.
52.
53.
54. Egyptian sepulchral mummy figures, made of a loose sandy paste, with a thick enamel glaze, blue-coloured by copper. These figures, which are usually sold by the Arabs to travellers, are largely imitated in Birmingham, and exported to Egypt, where they are deposited in the Pyramids, to be subsequently discovered. In the imitations the blue colour is usually produced by cobalt and oxide of tin.

55. Indo-Chinese grotesque group: mandarin and lion, or kylin.

56. Group of Hindoo figures: artisans at their trades.

57. Earthenware plate, with enamel glaze and conventional flower and leaf pattern in red and green; Indian.

58. Black ware bottle, with varnish glaze, silver filigree pattern; Indian.

59. Saucer, porous stoneware, with thick salt glaze and blue flower pattern, Persian, rudely made.

60.
61.
62.
63. Bottle and three mugs, two with handles, earthenware, with green glaze, from Tunis.

64.
65. Hour-glass-shaped vessels of earthenware, with rude white and brown patterns, used by the native tribes of Guiana; South America.

66. Earthenware pot used by the natives of Guiana.

67. Double bottle, with grotesque Aztec head, red ware, with black pattern, from Mexico.

68. Pickle-jar, from Hobart Town, Australia.

69. Group of ripe plantain fruit, modelled in clay (terra cotta).

70. Group of three cashew nuts, modelled in terra cotta; Madras.

71.
72. Pomegranates, in painted terra cotta.

73. Shaddock, modelled in painted terra cotta.

74. Cashew nut modelled in terra cotta.

75. Lemon, modelled in terra cotta and painted; Madras.

76. Guava ripe fruit, modelled in painted terra cotta.

77. Group of two custard apples, ripe and unripe, modelled in terra cotta.

78. Custard apple, in painted terra cotta; Madras.

79. Bunch of green grapes, modelled in painted terra cotta; Madras.

80. Guava, unripe green, in terra cotta.

81. Cucumber, modelled in painted terra cotta; Madras.

82. Globular bowl, with perforated casing in black lustred ware and gilding, from Ahmedabad.

Number.

83.
84.
85. Five small plates, or salvers, in lustrous black ware, ornamental flower and scroll patterns, coarsely scratched; edges of two scalloped.
86.
87.

88. Conical cover of vase, black lustrous ware; Bengal.

89. Wide-mouthed small pot, black lustrous ware; Ahmedabad.

90. Small cylindrical pot, with domed cover, black lustrous ware, from Bengal.

91. Tray, or coaster, small, circular, deep, straight rim, scroll pattern in dull black lines on lustrous ground; Bengal.

92.
93. Two yellow-glazed earthenware (pickle) jars, Madras.

94. Black-glazed, wide-mouthed, round-bottomed pot, from Nepaul.

95. Large jar, with cover, black-glazed ware; Nepaul.

96. Large brown-glazed vessel, with narrow mouth broken, round, thin bottom for exposure to fire; Nepaul.

97. Unglazed pot, set in basket of plantain leaves, with long handles, ornamentally plaited, and set with plates of talc under openwork plaiting; marked, charcoal-burner; Cachar.

The above, 69 to 97, were presented by the Right Hon. the Secretary of State for India.

HISTORICAL COLLECTION OF PORCELAIN.

EUROPEAN AND ORIENTAL.

ENGLISH PORCELAIN.

Old Worcester Porcelain.

Number.

1. 2. 3. Coarse-ware plates, moulded basket-work rim; deep blue line on edge, and bunch of flowers in centre, marked W.

4. 5. 6. Dessert or compot dishes, similar ware to former; moulded rim, deep blue edge, and scattered flowers on body; crescent mark.

7. 8. Two flower-stands, massive, fine paste, richly moulded and gilt; deep blue, with bunches of flowers in colours on white ground: mandarin mark.

9. Circular dish, very fine; one cross band in blue and gold; butterflies in centre, and bunches of flowers on sides, natural colours; mandarin mark.

10. 11. Two ovate scent jars, deep blue ground; white panels, with very fine bunches of flowers, natural colours; crescent mark.

12. Scent or flower jar, wide-mouthed; blue ground, richly gilt; white panels, with conventional forms of peacocks or pheasants, and sunflowers in Chinese style; mark, the mandarin square.

13. 14. Bowl, with salver and cover; bands of deep blue, with circular disks of white and red rays; interspaces white, with bunches of flowers in colours; Chinese style; imitation of the camelia pattern popular in Japan, and shown in No. 18; mandarin mark.

15. 16. 17. Tea-cup, saucer, and coffee-cup, similar to above; same mark.

18. Small Japanese tea-cup; to illustrate the original design the above Worcester specimens (13 to 17) were intended to imitate.

19. 20. 21. Bowl, tea-cup, and saucer, of white ware, with gold flowers; marked with cross-swords and handle; intended to represent a foreign mark; Tournay or Dresden; described by Maryatt as unknown.

22. Teapot, white, with blue hand and wavescrolls in gold; marked with word *Flight* (italics).

23. Coffee-cup, same pattern as 22, marked with crescent.

Number.

24. Teapot, white, with blue flowers and Chinese landscape; mark W; same as 1, 2, 3; fine ware.
25. Small ewer, white, with black printed landscapes and figures; no mark.
26. Flacon, with stopper; sprigs in enamel green and colours; no mark.
27. Cup, white, with Chinese landscape and figures in blue; crescent mark.
28. 29. Cup and saucer, white moulded with blue flowers; mark, a cipher moulding A or F; one of those described by Maryatt as unknown.
30. Small cup, white, with blue flowers; Chinese style; mark, ♂, very unusual.
31. Small jug, white, gold edge; bunches of flowers, natural colours; no mark.
32. 33. Cup and saucer, blue bands, with white scrolls and gilding; interspaces white, with red scrolls, nearly vertical; mandarin mark.
34. Jug, white, moulded with foliage in large leaves; no mark.
35. Set of three evaporating capsules, for chemical use; modern.
36. Small jug, of modern porcelain, made by Kerr and Sons, with filigree outer casing, richly gilt and jewelled; no mark.

Shropshire Porcelain.

37. Teapot, white, with blue and gold; flower sprigs; mark, S.
38. Plate, white, with blue and gold rim, and flowers in centre; mark, S.
39. 40. Cup and saucer, blue and white; Chinese willow pattern, with gold lines; mark, crescent on cup, cipher on saucer. See 27, 28, Worcester.
41. Small compotiere, white and blue flowers; crescent mark, evidently same ware as Nos. 4, 5, 6, Worcester, but named Shropshire by Department.
42. Cup, white, with blue and gold rim and sprigs of flowers; marked S; matches 38 and 44.
43. Cup, white, with blue ovals, and gold stars, and festoons; mark, S.
44. Cup, white, blue, and gold; mark, S. See 38 and 42.
45. Ewer on three feet; black manganese ware, with gilding painted in oil at Caughley, Shropshire.

Bow Porcelain.

46. Leaf-shaped dish, with flowers and birds, red, blue, and gold; Indian style; no mark.
47. Flacon, with stopper; pale yellow, with coloured sprigs and panels white, with landscapes purple; no mark.
48. 49. Two sauce-boats, large and small, white, with flower sprigs and butterflies; no mark.
50. Saucer, same design and style as 46; no mark.

Number.

51. Teapot and cover, small, white; embossed pattern, with flower sprigs and butterflies in colours.
52. Ewer, white, small, finely embossed, supported on pair of goats, couchant; handle, oak branch; on front, bunch of flowers, with bee in high relief; characteristic. A very rare and beautiful specimen, similar to that figured and described by Maryatt; mark on bottom, the triangle or delta Δ.
53. Ewer, fine white ornaments in high relief; wreath of rose stems round base; flowers and scroll-work at handle; mark, the Δ, or triangle of Bow.

Chelsea and Derby.

54. Plate, white, with flowers in green and gold edging; mark D and anchor.
55. Teapot, ovoid, white, embossed with flowers and foliage in colours; no mark.
56.–57. Two butter-boats, in form of rolled leaf, embossed with flowers in colours; no mark.
58. Flat scent-bottle, trefoil shape, green, with medallions and heads, man and woman, natural, on brown ground and gold ornaments; scroll handles; base, quadrilateral, with embossed rams' heads, and wreaths gilt; the dab marks on bottom of base.
59. Flower-pot, white and gold, small, with bouquet of moulded flowers in high natural relief and natural colours; dab mark on base.
60. Large vase or bowl, on foot, deep blue, with white mouldings, and panels with vases and garlands of flowers in colours, and gold vine wreaths; dab marks on base.
61. Group of figures; Amphitrite or Venus and Cupid seated on dolphin, with shell-fish and seaweeds; dab marks on base.
62. Neptune, with trident and dolphin, on rock, with groups of shells, seaweeds, and corals; match of 61, in natural colours; dab marks.
63. Figure of country girl with basket of eggs and apron full of flowers; attached flowering shrubs, natural colours; dab marks on base.
64. Figure of Sir John Falstaff, in colours; usual dress; dab marks.
65. Figure of Britannia, with lion and warlike instruments and flags; dab marks on base.
66. Figure of a warrior in modern costume (1760 ?), probably the Duke of Cumberland, who was a patron of the Chelsea Porcelain Works. A naked child at his feet holds a shield with a negro's head. Dab marks on base.
67. A warrior, in Roman military costume, with shield, &c., on square pedestal, embossed; no mark.

Number.

68. Figure of old man, in classical dress, with cloak; colours; dab marks on base.

69. 70. Two-handled cup, with cover and saucer; blue flower on white ground, and gilt edge; old Derbyshire; no mark.

71. Plate, richly decorated; lavender ground, and gilt scroll border. Centre, a tableau, in colours, from Shakspeare's "King Henry V." Fluellen makes Pistol eat the leek. On back, descriptive extract from play. Mark, crown and D, with cross-lines. Old Derbyshire.

72. Plate, richly ornamented; green ground, with gilt scroll edge. Centre, a tableau of the balcony scene from Shakspeare's "Romeo and Juliet," in colours. On back, descriptive extract from play. Mark, crown, D, and cross-lines. Old Derbyshire.

73. A jug, barrel-shaped; white ground, with flowers, in colours; no mark. Chelsea or Derby.

74. Plate, white ground, with scrolls embossed and gilt; birds and flowers, in natural colours; glaze soft, much cracked; mark, golden anchor, with support point marks. Chelsea.

75. Small teapot, ribbed; wire handle; white ground, with gold lines; birds and flowers, in natural colours. Chelsea or old Staffordshire?

76. Stand salver on tripod, white ground, with gold lines and wreaths; sprigs (Bourbon?) of blue flowers and gold; mark, crown and D, with cross-lines. Old Derbyshire.

77. Ecuelle, or fruit salver; white ground, diapered with roses, with gilding on edges embossed. Old Derbyshire. Usual crown and D mark.

78. Dessert plate, same pattern as 77.

79. Fruit dish, or ecuelle; represents a cabbage leaf, in colours, with butterflies, caterpillars, wasps, and lady birds, natural colours; mark, anchor in red. Chelsea.

80. 81. Compotiere, or butter-pot, with cover and saucer; white ground, with gold lines; wreaths and sprigs of flowers, in blue and green (Bourbon sprig). Old Derbyshire. Usual mark.

82. 83. Cup and saucer, white, with deep blue and gold margin. Old Derbyshire. Usual mark, in purple.

84. 85. Cup and saucer, very fine thin body, white ground, with bouquets of flowers in natural colours. Old Chelsea. Mark, anchor in red.

86. 87. Two coffee-cups, same set, white fluted body, with gilt edge and festoons of flowers in colours. Old Chelsea. Derby mark D, with cross, anchor in gold.

88. Cup, white ground, with insects in colours. Old Derby. Usual mark, purple.

89. Oval compotiere, or bracket salver, embossed, white ground, painted with insects and flowers; handles rising from bunches of coloured flowers in high relief. Old Chelsea. Red anchor mark.

Number.

90.
91. Two pastile or perfume vases, richly moulded and gilt; scroll ornaments in colours; 91 broken. Old Derby. Usual mark, purple.

92. Large cup, ribbed crenate on edge; landscapes, flowers, and insects in purple; printed design. Chelsea. No mark.

93.
94. Two Chelsea cups, small; no mark; ribbed and crenate on edge; pattern in colours; Chinese design, flowers and animals; no mark.

95. Cup, white ground, ribbed gilt edge; festoons of flowers in green. Chelsea. Derby mark, D and cross, anchor in gold.

96. Vase and cover, white ground; rose branch, with flowers and sprig of centaury in low relief and colours. Chelsea. No mark.

96.*bis.* Fine group in Chelsea porcelain. Dab marks. Time clipping the wings of Cupid. Presented by William P. Pike, esq., for Colonel L. Smith O'Connor, C.B.

SWANSEA, SPODE, AND SUNDRY OLD ENGLISH PORCELAINS.

97.
98. Cup and saucer, embossed basket-work border, white ground, bunches of flowers in lavender; mark, cross + (Old English ?), S. and A. D. The paste and mark resembles that given by Maryatt for Bristol.

99.
100. Cup and saucer, white ground, with gold lines, green wreaths, and festoons of laurel or myrtle in flower; mark, a cross +, same as last objects. From the paste and character, this is most probably Bristol.

101.
102. Cup and saucer, white ground, with gold edge and centre, fluted; mark, Swansea, in red letters on back

103.
104. Two compotieres or fruit dishes of stone chinaware, moulded with pattern of Chinese style; flowers and landscape in gold and colours. Spode.

105.
106. Sauce or sugar basin, with cover and stand, oval, same design and set as last. Spode.

107. Large fruit dish, on foot, with moulded handle ends, of same set and design as above.

The above five objects have on base the trade-mark printed (Spode) in a square mandarin cipher.

108. Coffee-cup, blue ware, Chinese landscape pattern; mark, *Spode* on base.

109. Tray, mounted with ormolu rim and handle; ground, green leaves with veins, in gold and crimson rays from gilt centre; base white, with mark, *Spode*, in red.

110. Cup or basin, white ground, ribbed with bunches of flowers, in colours, in Chinese style. S. & A. Make unknown, probably Chelsea.

111.
112. Cup and saucer, white ground, gilt edges, painted with Cupids with flowers and books; make unknown. S. & A.

GERMAN PORCELAIN.

A.—DRESDEN (MEISSEN).

Number.

1. Bowl, mounted in ormolu, with paintings of Perseus and Medusa and Apollo. Mark, Marcolini period.
2. Plate, with figures of goldfinches and insects. King's period mark.
3. Plate, flowers in blue. Mark, Höroldt's period? Modern?
4. Plate, green rim, with shepherd and lambs. Mark, Royal period.
5. Plate, bleu du Roi, with landscape and figures. Ordinary mark.

6. } Oval brooches, with figures of angels from Madonna de San
7. } Sisto, by Raphael. Modern.

8. Small white compotiere or sauce cup. Royal mark. Heart-shaped flowers in relief. 2913.
9. Saucer, brown ground, outside flowers in purple. Ordinary mark. Department 3901.
10. Saucer, with river scene, in black. Ordinary mark.

11. } Cup, with cover, and saucer, Rose du Barri, with landscape
12. } and figures richly painted. Ordinary mark. Cut through, showing it was not painted at Dresden.

13. } Cup and saucer, pastoral subject, in gilt medallions. Mar-
14. } colini.

15. } Cup and saucer, painted with fruit, flowers, and insects. Mark,
16. } Höroldt's.

17. } Cup and saucer, painted in fruit, in buff pattern. Mark,
18. } ordinary.

19. }
20. } Cup and saucer, painted with fruit and insects, full colours.

21. Oval compotiere, painted in flowers. Ordinary mark.
22. Oval tray, richly gilt, and painted with landscape.
23. Deep oval porcelain dish, painted with flowers, and embossed border. Period of mark, royal.

24. } Cup and saucer, richly gilt, and painted landscape and figures.
25. } Usual mark.

26. Cup, yellow ground landscapes and figures, in medallion. Oldest date. Caduceus mark.
27. Deep circular dish, painted in flowers, large. Ordinary mark.
28. Salad bowl, circular, painted with flowers.

29. } Pair of globes, terrestrial and celestial, with circles. First
30. } period of Swords mark.

31. Small vase with handle, and cameo of blue ground, with two profiles in white relief.
32. Small saltcellar, painted with figure subjects.
33. Trefoil-shaped basket with raised handles, painted with birds and insects. Royal period mark.

Number.

34. }
35. } Figure of peasant seated, holding bunch of grapes.
36. Cream-ewer, yellow ground, painted with landscapes.
37. Cup and cover, painted with Watteau subjects. Mark cut through and gilt. Paintings not done at Dresden.
38. Coffee-cup, old white Böttcher ware pattern, figures in relief. Grotesque subjects.
39. Coffee-pot, red glazed Böttcher ware, silver festoon decorations.
40. Red teapot, Böttcher or Elers. From S. and A. Department.
41. Ditto smaller. Ditto.
42. Plaque, painted, with head of Christ, after Guido's Ecce Homo, by Peetz of Dresden. Manufactured by Heinrich Brucker. Dresden.
43. }
44. } Circular salver with jug and cover, very richly gilt and painted. Central landscapes in colours and surrounding medallion landscapes in pink. Watteau subjects of river and coast scenery, with castles and ships. Marks, crossed swords on jug and F on salver, in blue, with Æ—12, in gold, on both. From S. and A. Department.

B.—HÖCHST PORCELAIN.

45. Plate, pink rim, painted with flowers on rim, and classical picture of Perseus and Andromeda in centre. Mark, blue wheel.
46. Large oblong salver, painted with baskets of fruit and flowers. Blue wheel.
47. }
48. } Cup and saucer, painted with landscape and fruit. Red wheel.
49. Milk jug, painted with landscape and fruit: broken. Red wheel.
50. Milk jug, Chinese figures and insects on white ground.
51. Milk ewer, flower on white paste. Mark, red wheel.
52. Plate, with flowers, white, embossed in relief, and flowers painted in purple. Mark, blue wheel and crown.

C.—BERLIN PORCELAIN

53. Richly gilt and painted plate. Metzen and his wife. Interior from picture in Dresden gallery. Modern eagle mark.
54. }
55. } Cup and saucer, rich royal blue, finely painted, with classical figures in cameo. Sceptre mark.
56. }
57. } Cup and saucer, white ground, painted landscapes. Sceptre.
58. Lithophane, white, broken.
59. Lithophane, girl praying, coloured. Modern.
60. Evaporating dishes, capsules and crucibles, chemical apparatus. Modern.
61. Bust of Goethe. Biscuit porcelain. Modern.

Number.

62. Plate, painted with wild mallard, Magdeburgh china. Modern.
63. Pipe-head, painted with death of Poniatowski.
64. Pipe-head, painted in wood pattern, with landscape.
65. Large ovate vase, blue, painted in Chinese style.
66. Globular teapot, broken, painted with birds. Sceptre.
67. Deep plate, raised border, classical figures in relief, and cameo with figure in centre. Sceptre mark.
68. Teacup, white and painted flowers. Sceptre.
69. Lithophane, white, with coloured glass framing. Italian peasant woman.
70. Lithophane, coloured. Madonna della Sedia, by Raphael.

D.—FÜRSTEMBERG.

67.–73. Dejeuner service of two cups and saucers, cream-ewer, coffee-pot, and large circular salver, painted with flowers, in groups and festoons. Marked letter F.

74. Group of figures, modern costumes, gentleman and lady.

75.–76. Salver and jug, white opaque ware, simple fluted and basket-work moulding, gilt edges. Pattern, sprigs of flowers in purple pink, printed. Mark, F.

E.—WALLENDORFF, SAXE-COBURG.

76.–83. Dejeuner service, consisting of two cups and saucers, coffee-pot, sugar bowl and cover, milk ewer, and large square salver, white ground, decorated with garlands and arabesques, painting and gilding. Mark, W.

84. Saucer, presented by S. and A. Department.

Limhach Thuringier.

85.–86. Cup and saucer, white, with linear arabesque design, in deep blue. Trefoil mark.

87. Small cup and cover, painted with flowers.

Rudolstadt.

88. Small coffee-pot, painted with pastoral medallions.

Arnstadt, in Gotha.

89. Oval plateau, with two raised handles, painted with flowers.
90. Chocolate cup and saucer, white ware, slightly moulded in foliage, made by Henneberg and Co., in Gotha. Modern.

F.—VIENNA.

Number.

91. }
92. } Cup and saucer, yellow ground, landscapes in medallions.
93. Oblong salver, with raised edges and handles, painted with bouquets of flowers.
94. Plate, set in ormolu mounting, with handles, and birds, painted with scene of tents and hussar.
95. Small tazza, on three legs, and handle, rose in centre.

G.—FRANKENTHAL, PALATINATE.

96. } Two fruit or comport dishes, in shape of vine leaves, white,
97. } with gilt edges, and painted with flowers.
98. Sauce-boat, with richly moulded and gilt handles and spout, in serpents, painted with landscapes and birds.
99. Oval tray, matching 98, with embossed flowers in white ground, and paintings of landscapes, birds, and flowers.

Ludrigsburgh—Kronenburgh.

100. Teapot, embossed, scale pattern, painted with flowers.
101. }
102. } Milk jug of same set, with cup and saucer to match. Four
103. } pieces in set.
104. Saucer, from Department of Science and Art.
105. Oval-shaped bottle, grounded with ornaments in purple. Landscape in colours on white ground on front. German porcelain. From Science and Art Department.

HOLLAND PORCELAIN.

A.—HAGUE.

1. Scent jar and cover, square, painted with flowers and medallion, pink landscapes.
2. }
3. } Cup and saucer, white ground, painted with flowers.
4. Square tray, with raised edges, pink, and painted garlands of flowers.

B.—AMSTERDAM.

5. } Large oval bowl, with openwork edges, gilt on white ground,
6. } with garlands and sprigs of flowers in blue and green; with oval tray in similar style.
7. }
8. } Cup and saucer, white ground, painted in flowers.
9. }
10. } Cup and saucer, painted with birds.
11. Cup, painted with flowers.

Number.

12. Triangular shaped pot, and cover, with figures in Sepia tint.
13. Sugar pot, and cover, floriated ornaments in blue and gold.
14. Plate, gilt border, with sprigs of coloured flowers.

DENMARK PORCELAIN.

COPENHAGEN.

1. Plate, with openwork gilt rim, and painted fruit centre. Broken.
2. } Cup and saucer, painted with flowers. Cracked.
3. }
4. Bass-relief medallion, allegorical figure of the seasons of the year, with circle of zodiac signs.
5. Bass-relief medallion, allegorical figures of Wisdom, Experience, and Youth.
6. Statuette of the Redeemer.
7. Statuette of female cupbearer, draped.
8. Statuette group of Hercules and Omphale.

RUSSIAN PORCELAIN.

ST. PETERSBURGH.

1. Figure of boy with goose.

FRENCH PORCELAIN.

A.—SEVRES PORCELAIN.

1. Plate of old Sevres, bleu du Roi lines, with rose sprigs.
2. Plate, white, with groups of flowers in mat gold.
3. } Chocolate cup and saucer, white, with bunches of purple pink
4. } flowers, edges gilt.
5. Mug, of same design.
6. } Cup and saucer, of a very rich pattern, green, white, and
7. } gold, with bunches of flowers.
8. Cream-ewer, on feet, with very rich design in gold and colours. Imitation of Chinese pleasure boat, trees, and landscape.
9. } Cup and saucer, blue, gold, and white design, with sprigs of
10. } natural coloured flowers.
11. Egg-cup, coloured flowered pattern.
12. } Small fancy cups, white polygonal, with groups of coloured
13. } roses and other flowers.

Number.

14. Chocolate cup, very rich design, gilt, with garland of roses and other flowers finely painted. Handle broken.

15. Very small cream-ewer, deep bleu du Roi and gold.

16. Large flat cup, green, white, and gold, rich scroll pattern, with bunches of flowers.

17., 18. Cup and saucer, rich deep bleu du Roi and heavy gold pattern. On the cup, landscape and boy fishing.

19., 20. Two vases of modern soft paste Sevres porcelain, purchased from Exhibition of Manufactures at Dublin, in 1853; white with gold edge, and spiral wreaths of small roses, flowers, and leaves.

21., 22. Cup and saucer, of rich deep bleu du Roi and gold, with pattern of classical objects of music and war.

23., 24. Two plates, same pattern, but unequal in depth of colour. Blue scroll and bunches of coloured flowers.

25. Two-handled cup and cover, white, edges gilt. Pattern, bunches of flowers in colours. Green mark.

26. Shallow dish or large saucer, white, with gold and bunches of flowers. Belongs to 25.

27., 28. Porcelain plaques, painted in flowers for decoration of furniture.

B.—PORCELAIN DE LA COURTILLE.

29. Ink and pen stand, white with gold, and small sprigs of blue polygala, known as the Bourbon sprigs.

30. Flask cooler or flower-pot, white, with blue sprigs or branches.

31., 32., 33. Cup, saucer, and small coffee-pot, white, with bands of pink and gold, garlands and festoons of flowers in colours.

34. Plate, with groups of birds, one large in centre, and four small round edge.

35., 36. Two plates, white, gold edges. Bunches of flowers in colours.

36(*bis*). Large oval dish, edge moulded and gilt. Painted with bunches of flowers in colours.

C.—PORCELAIN DE LA REINE.

(Marie Antoinette.)

37. Pen-and-ink stand, one central case, white and gold lines, small Bourbon sprigs and colours.

38. Pen-and-ink stand, with two cups, white, with gold lines and small Bourbon sprigs.

39. Saucer, white, with rich gold, fine pattern. Blue waves, with ovals and garlands in colours, gold sprigs in centre.

40., 41., 42., 43. Two cups and saucers, white and gold, with large sprigs, Bourbon design.

D.—PORCELAIN CLIGNANCOURT.

Number.

44. Cream jug, white and gold, with bunches of flowers in colours.

45. 46. Two saucers, white, with rich gold edgings, scrolls and sprigs, and bunches of flowers in colours.

E.—PORCELAIN D'ANGOULEME.

47. 48. Two saucers, in white and gold, with large Bourbon sprigs.

F.—PORCELAIN DE CHANTILLY.

49. Small oval fluted basin, soft body and glaze. Pattern, groups of flowers in imitation of Chinese style.

SUNDRY OTHER FRENCH PORCELAINS.

50. Porcelain plaque, with Cupid in pink, mounted in gold for a brooch.

51. Inkstand in shape of shoe, modern, Paris.

52. Set of capsules and crucibles for chemical use, made at Bayeux.

53. 54. Chocolate cup, with stand, white and gold, with garlands and bunches of flowers in colours. Marked P, with imperfectly formed crown, not given by Maryatt or Brogniart. Probably "*Porcelain de Monsieur.*" Soft part, modern.

55. Two-handled chocolate cups, blue and green wreaths, with bell-shaped flowers on white. Purchased from Department of Science and Art.

56. Cup and saucer, white, embossed. Scale pattern. St. Cloud. Science and Art Department.

BELGIAN PORCELAIN, TOURNAY.

1. Plate, soft body, and glaze, white, gold edge. Pattern, pink. Bunches of flowers on edge, landscape in centre. Broken and repaired.

2. Bowl, white reeded moulding. Linear pattern, with flower in blue. Mark in blue.

3. 4. Cup and saucer, similar in material and pattern to No. 2.

ITALIAN PORCELAIN.

Naples—Capo di Monte.

Number.

1. Saucer, white and gold, with green band. Mark, N and crown.
2. Saucer, white and gold. Countrywoman and little girl in colours; on reverse, "Del Paese di Gallo de Prato."

3.
4.
5.
6.
7.
8. } Sugar-bowl and cover, with two cups and saucers, white and gold, very richly ornamented with embossed figures in natural colours, with trees in high relief, representing classical subjects, festival processions, &c.; red coral handle on cover of bowl.

Venice.

9. Plate, in white, with gold edge, and clusters of flowers in natural colours. Mark, anchor.

PORTUGAL, OPORTO.

1.
2. } Cup and saucer, white and gold, with landscape printed in black on bottom. Fabrica de Porcelana de Verreir a Pinto e Filhos. Vista allegre em Portugal Parte d'Este.

CHINESE AND INDIAN EARTHENWARE AND PORCELAIN.

1. Brown ware plate or salver, with Chinese characters.
2. Teapot, with Chinese inscriptions, very fine brown ware.
3. Small teapot, Chinese, ordinary brown ware.
4. Salver, on foot, of fine black ware; upper surface very richly decorated with flowers and foliage in enamel colours.
5. Cup, in brown ware, richly ornamented with flowers in enamel colours and cracklin glaze.
6.
7. } Two water bottles, in brown ware, with cracklin glaze, with figures of lizards in high relief crawling up neck.
8. Sauce frame, in seven pieces, forming a square, with hexagon centre; hard white ware, green ground with yellow pattern and sides.
9. Small plate, blue and white oriental china, fancy design.
10. Water bottle, white ware, blue landscape pattern.
11. Large octagonal bowl, with landscape in blue, and inscription in Chinese characters on base.
12. Blue and white plate, of Chinese porcelain, with landscape and fancy design.
13.
14. } Water bottle and stand for nargileh or hubble-bubble oriental pipe; blue and white porcelain, with landscape.
15. Sauce-boat, white, with very rich decoration in small flowers, natural colours and gold.

Number.

16. Large plate, white, with flowers on edge, and gold band; centre, a Chinese musical party of six figures, natural colours.
17. Saucer, in real fancy pattern.
18. Saucer, with flowers in raised enamel colours.
19. Small cup, white, with flowers.
20. A similar small cup, but pattern different.
21. Small blue and white cup, edge cut in circular mitreing.
22. Small bowl, white, with flower pattern in red. On base an inscription in Chinese characters, translated by M. Franks, of British Museum, to mean, "made in the period Ching-hwa, A.D. 1466–1488, under the Emperor Hein-Teung of the Ming Dynasty."
23. Large plate, white, richly decorated in natural colours, with raised enamel flowers and fancy pattern.
24. Teapot and cover, handle broken, flowers and foliage in natural colours.
25. Cup in translucent porcelain, with trees and flowers in enamel colours.
26. Bowl with flowers, in transparent colours. Mark on base, probably a maker's cipher.

27.–28. Large saucer and bowl, of fine translucent porcelain. Rich ornament of raised flowers in enamel colours.

29. Small cup and saucer, of fine translucent china, richly ornamented with flower in enamel colours.
30. Plate in celadon green porcelain, with design of flower baskets. Scrolls with inscriptions, arms, and vases in rich raised enamel colours.
31. Saucer in Japanese brown, and one with opaque yellow glaze, and pattern in white and colours and flowers. Centre, boy with wheelbarrow, and man apparently rebuking him.
32. Octagonal cup, in white translucent porcelain.
33. Small milk-jug, in white translucent porcelain.
34. Plate in eggshell porcelain, black and gold pattern, printed with landscape in centre.
35. Small cup, white and gold, with fancy flower pattern in red.
36. Small cup, red ground, with fancy flower pattern in red and white.

37.–39. Saucer, with cup and cover of beautiful eggshell, translucent porcelain from Japan; white with landscape pattern in red, partly embossed in low relief. Japanese inscription on base.

40.–41. Two jars in brown ware, with cracklin porcelain glaze.

42.–43. Two bottles, in porcelain, richly decorated with flower and gold round neck, and flowers, branches, and figures in raised enamel colours on sides, and humorous Chinese inscriptions. Glaze, cracklin in some degree.

Number

44. 45. Monstrous lions, sitting: one with young, one trying to climb up; the other with fore-paw resting on a globe. These figures are called by the Chinese Ky-lin.

46. A small porcelain seal, found in Ireland, from the collection of Mr. Huband Smith, with Chinese inscription at base, and a lion or ky-lin above for handle. See Mr. Ed. Getty's Essay on Chinese seals found in Ireland.

These seals were supposed by him to be very old, but are now believed to have been introduced by an eminent tea merchant, named Sweeny, who imported and presented them in great numbers to his customers about 150 years back (1710).

47. Plate, with rich pattern in blue, red, and gold.
48. Plate, white, with flowers on edge, and landscape, with flowers and pair of deer in centre, in enamel colours.
49. Plate with landscape, and figures in blue and white.
50. Plate, with gold edge, flowers and butterflies in raised enamel colours.
51. Plate, extremely richly decorated, in relief, with enamel colours; dragons, and lizards, and demons, confusedly intermixed, a cipher or inscription in gold and red.
52. Plate, white, with landscape in raised enamel colours and gold.
53. Cup, with flowers, shrubs in colours, with divisions by green in bands, as if for arbours.
54. 55. Pair of octagonal scent jars, white, with blue and red flowers; perforated necks and caps.
56. Octagonal scent jar, in blue and white pattern in flowers and birds; neck broken.
57. 58. Pair of mandarin jars, round, richly coloured in relief enamel; moulded birds and lizards round neck in high relief, with illustrations of Chinese customs and ceremonies on sides, in groups of figures and interiors.
59. Mandarin jar, of superior material and style of decoration; flowers in enamel on celadon ground; four paintings on sides and neck, representing Chinese domestic life in numerous groups of figures.
60. Earthenware water-bottle, with green glaze, employed at Constantinople.
61. Large bowl of nargileh, or hubble-bubble oriental water pipe, richly coloured in mat colours from Ceylon; exhibited in London in 1851 as the King of Candy's teapot, and presented by the Royal Commissioners to the Museum of Irish Industry.
62. 63. Two very large and fine jars of Chinese porcelain, with blue and white raised figures and decorations on pale celadon green ground. One purchased in fragments at the Exhibition in Dublin of 1853, and put together in the Museum; the other whole.

COLLECTION,

ILLUSTRATING THE MANUFACTURE OF

ENAMELS AND VITREOUS MOSAICS.

COLLECTIONS OF ENAMELS, VITREOUS MOSAICS, AND BEADS.

Number.

1. Embedded enamel reliquary plate, with figure of Redeemer, gilt, with vermilion glory, on blue ground, with gilt scroll ornaments, Byzantine, about fifteenth century.

2. Similar, somewhat smaller reliquary plate, figure of Redeemer, gilt, white and blue glory, ground brown, in cross hatching, with blue cross bands and gold points. Piece cut out under feet of figure, and closed by slip, probably for reception of relic; Byzantine.

3. Painted enamel in colours of Limoges, Madonna with Dead Christ; sixteenth century.

4. Fine painted enamel en grisaille of Limoges. Combat of cavalry with elephants, probably one of Alexander's battles. Date about the end of fifteenth century.

5 to 16. Fine series of twelve Byzantine, or early Venetian, painted enamels, representing the stages of the Passion, or Via Crucis. These enamelled plates are stated to have formed portion of a shrine formerly belonging to Cardinal Fesch, uncle to Napoleon the Great, at Rome, and were disposed of after his death.

17. Snuff-box in black enamel, embedded on silver or Niello work. This form of enamel is of peculiar interest, as having given origin to the art of copperplate engraving by Mastegna in (date ?)

18, 19. Grotesque flour or pepper-boxes, in painted enamels on copper; Chinese.

20. Enamelled saltcellar, white, on copper, with landscape; Chinese.

21. Enamelled plate, white, with gold on copper; Chinese.

22. Sweet-meat tray in centre, and eight separate compartments, white, on copper, with Chinese landscapes and figures.

23. Small box, white, on copper, with pink landscape and shipping; Chinese.

Number.

24. Small tray, white, and Chinese objects.

25 to 27. Series of specimens illustrating the manufacture of enamelled watch and clock dials, containing the enamel; a glass rendered opaque white by peroxide of tin.

Six watch dials, in various sizes and designs.

Four fire-clay rings, on which the watch dials are supported in the furnace, to fuse the enamel.

28 to 35. Series illustrating the mode of manufacture of Roman or Florentine mosaics from enamelled glass:—

28. Tray of glass-coloured rods used in making the mosaics.

29. File and pincers used in cutting and adjusting the fragments of glass rods.

30. Resinous cement used to imbed the mosaic pattern in the black marble, or black glass base, and Tripoli, or rotten stone, used in smoothing down the surface.

30. Half finished brooch, showing process of construction.

Three small mosaic brooches:—

31. One, aventurine ground, with flowers.

32. One, red grapes on brown ground.

33. One, green and blue, oval wave pattern, with small flower centre.

34. Large circular mosaic plate, with bunch of flowers.

35. Large circular mosaic plate of Ruins of Forum in Rome.

36. Card, of various patterns, of moulded glass buttons.

37. Shirt buttons in white glass enamel.

38 to 52. Collection of specimens of varieties of beads and bugles, manufactured for the European and African markets.

53 to 68. Tray of sixteen objects of toys, ornamented with beadwork, from India, presented by the Right Honorable the Secretary of State for India.

69 to 72. Four series of glass and ornamented bugles, used as ornaments for the wrist and ankles in India, presented by the Right Honorable the Secretary of State for India.

73. Crystal collar of beads.

74. Bead mat, made by the boys in King Edward's Reformatory.

75. Semi-opaque glass, prepared as ground for enamelling on iron for culinary purposes.

76. Frit composition for glaze on iron vessels.

77. Iron pipe invested with blue glaze, for conveying water.

78 to 83. Pipe, pans, ladle, and saucepans, coated with transparent glaze, for domestic uses; Austrian.

84, 85. Iron wash-hand basin prepared for glazing; same glazed, and same printed with pattern in blue glaze. Presented by the manufacturer, T. F. Griffiths, Birmingham.

BRITISH AND FOREIGN

ILLUSTRATIONS OF THE MANUFACTURE

OF THE

DIFFERENT KINDS OF GLASS.

COLLECTIONS ILLUSTRATING the Manufactures in Glass and Enamel.

Ancient Roman Glass.

Number.

1. Cinerary urn, containing bones, of ancient Roman glass.
2. Salver of ancient Roman glass. This object is of peculiarly difficult construction, and indicates a very great degree of proficiency in the manufacture.
3. Ancient Roman glass bottle or lachrymatory.

The above three specimens were obtained.

Mediæval Venetian Glass.

4. Mug, coated and frosted in the manner lately revived by Apsley Pellat, moulded ornaments in relief, gilded.
5. Cylindrical vessel, with spiral white lines interfused.
6. Conical glass, with doubly spiral white lines interfused.
7. Cup with white lines in bands, and spirals interfused.

The above three objects indicate an early period in Venetian art.

8. Oxoidal bottle, with bands and folded spirals of exceedingly fine filigree; white glass interfused. An extremely beautiful specimen of most perfect work.
9. Scent bottle, representing Dolphin, in opaque white glass, in transparent mounting and ornaments.
10. Candlestick.
11. Circular plate of crown glass, with armorial bearings—shield, with stag.

Modern Glass, Hard.

12. Cylindrical flower-stand, cut ruby glass, with circles of transparent ground.
13. Flower-stand, opaque white, with gilding on pink ruby ground.
14. Conical flower-stand, rose opaque, with silver vine leaf, spiral pattern.

Number.

15. Goblet, amber, on transparent ground, intaglio landscape, with stag and trees.
16. Wine-glass, uranium, yellow, with scroll and honeysuckle ornament intaglio.
17. Scent bottle, uranium, yellow.
18. Wine-glass, ruby wine colour, cut.

19, 20. Pair of vases, blue and white ground, richly gilt; pattern—large bunches of flowers in colours, lip edge waved.

Soft (Flint) Glass.

21. Jug, frosted in imitation of the old Venetian frosted glass—*See No.* 4.
22. Flower-glass, opaque, uranium, yellow.
23. Flower-glass, opaque, cobalt blue.
24. Flower-stand, cup and shank, with twisted make, white, with pale opaque green.

25 to 27. Unfinished flower-stands, opaque white, showing stages of process for applying gilding on glass.

28 to 30. Specimens showing mode of taking up the successive layers of coloured glass to form the patterns by cutting. A wine-glass partially formed, and the coloured layer partly ground off, in blue and in opaque white glass.

31, 32. Paper weights, formed by masses of transparent flint glass with diversified fragments of variously coloured glass, interfused, in imitation of the old Venetian.

33 to 36. Large bowl on stand, with two water crofts formed of glass in three layers, viz., blue and opaque white on transparent ground.

37. Water vase, opaque white, muffed, with classical scroll band design in encaustic black.

38, 39. Water croft and goblet of muffed glass, painted with designs of yellow and blue water plants in colours.

40, 41. Two flower jars, opaque white, gilt lines, and bunches of flowers in colours.

42. Small vase, opaque blue, muffed; classical design, with figures in black and colours; imitation of ancient Roman.

43. Series of sixteen objects, on frame, showing successive stages of manufacture of a cut wine-glass, and of chandelier glass.

44 to 46. Materials employed in the process of cutting and polishing flint glass.

47 to 49. Specimens illustrating the manufacture of wine-glasses and decanters.

50 to 55. Specimens illustrating the manufacture of glass with patterns produced by compression.

56 to 59. Series illustrating the process of making a water croft or decanter.

Number.

60. Cut-glass bowl of glass, coloured by cobalt.

61 to 71. Series of specimens of the materials used in the manufacture of flint glass.

72 to 81. Series of nine specimens illustrating the stages of the process of making a glass jug.

82, 83. Process of ringing a decanter.

84 to 95. Series of eleven specimens illustrating the stages of manufacture of a wine-glass.

96 to 101. Six specimens showing the process of making a glass lamp chimney.

102 to 107. Six specimens showing stages of manufacture of Argand and other lamp glasses.

108 to 110. Stages of making a chemical retort.

111 to 115. Illustrations of the process of making and cutting out watch glasses.

116 to 119. Specimens of white, yellow, green, and red lenses for lamps, as used for railway purposes.

120, 121. Opaque white lamp shades.

122. Narrow flower vase, with opaque white spiral lines; Prussian.

123. Small flower vase, green, with white spiral lines in bands; English.

124 to 142. Series of specimens of glass coloured, with the names of the colouring material cut or stained on the glass, to illustrate the processes and materials of staining glass.

143. Landscape after Claude Lorraine, painted and burned in on glass.

144 to 153. Chemical preparations employed in colouring glass.

154 to 162. Series of alkaline and metallic materials employed in the manufacture of flint glass.

163 to 165. Siliceous sand from Rostellan, near Queenstown, Cork.

166. Fine silica, obtained from same by washing.

167. Fine sand, for glass making, from Sutton, near Howth, county Dublin.

168. Pure white sand from Muckish Mountain, county Donegal.

*168. White sand from Malinmore, county Donegal.

169. Portion of cylindrical polyzonal lens, as used in lighthouses, on the dioptric construction.

170. A circular polyzonal lens for lighthouses, on the dioptric construction proposed by Fresnel.

171. An annular lens on same principles of construction.

172 to 180. Specimens of glass prepared for optical purposes.

The above, 170 to 180, presented by Messrs. Chance, Birmingham.

Crown, Plate, and Bottle Glass.

1, 2. Models in clay, raw and fired, of the melting pots used in the manufacture of crown glass.

Number.

3. Specimen of pot clay, Stourbridge, Staffordshire.
4 to 16. Series of specimens illustrating the materials employed in the manufacture of crown (window glass).
16 to 18. The materials for crown glass, half and entirely fused together.
19 to 23. Series of specimens illustrating the process of manufacture of the circular sheet of crown window-glass, by flashing.
24. Full-sized circle of crown glass.
25 to 27. Series of specimens illustrating the manufacture of flatted window-glass, by splitting up a cylinder.
28, 29. Cylinder and opened plate of glass, from the Glass Works of Bennert and Bifort, Charleroi, Belgium.
30 to 36. Series of specimens exhibiting the materials used in the manufacture of common bottle glass, and the stages of its preparation.
37 to 45. Series of specimens illustrating the stages of manufacture of a pint bottle, Dublin Bottle Works.
46 to 52. Series of specimens illustrating the manufacture of a wine bottle.
53, 54. Specimens of old Irish bottles, probably about 1700, found in mine-shafts, Ballycastle, county Antrim, and in county Monaghan.
55 to 59. Materials used in the manufacture of fine plate-glass, used for looking-glasses.
60 to 68. Series of specimens of looking-glass plate, illustrating the stages through which it passes in casting, rolling, grinding and polishing.
69. Specimen of same plate, finished and silvered in the ordinary manner by quicksilver applied on tinfoil.
70 to 72. Goblet and globes of glass, silvered by the new process of chemical deposition upon solution of nitrate of silver.
73 to 112. Series of specimens illustrating the manufacture and varieties of applications of the coarse or inferior plate-glass to domestic uses.

DUBLIN: Printed by ALEXANDER THOM, 87 & 88, Abbey-street,
For Her Majesty's Stationery Office.

No. 2.—Rocks.

Science and Art Department

OF THE

COMMITTEE OF COUNCIL ON EDUCATION,

MUSEUM OF IRISH INDUSTRY.

INVENTORY CATALOGUE

OF THE

SPECIMENS ILLUSTRATING THE COMPOSITION, STRUCTURE, AND OTHER CHARACTERS OF THE

IRISH, BRITISH, AND FOREIGN ROCKS,

IN THE

COLLECTION

OF THE

MUSEUM OF IRISH INDUSTRY, DUBLIN.

DUBLIN:

PRINTED BY ALEXANDER THOM, 87 & 88, ABBEY-STREET,

FOR HER MAJESTY'S STATIONERY OFFICE.

1862.

This Catalogue of the Rocks has been drawn up by J. B. Jukes, F.R.S., M.R.I.A., Professor of Geology, Museum of Irish Industry.

The Collections occupy the Eastern End of the Lower South Gallery of the Museum.

R. K.

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Rocks altered by General Metamorphic Action.

Rocks altered by Local Contact.

Aqueous Rocks.

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Mechanically formed—Argillaceous.

Chemically or Chemico-organically formed.

PART II.

Typical European Rocks, chiefly Igneous and Metamorphic, purchased from Dr. A. Kranz.

CATALOGUE

OF THE

ROCK COLLECTION.

Each specimen has one red number painted on the specimen. This is the first number given in the Catalogue. Most of them have also a second smaller number on a label, which may be called the collecting number, as it is affixed immediately on the collection of the specimens, and refers to the specimen registers kept by the Geological Survey. These are the second smaller numbers prefixed to the description of the specimens, most of which have a distinctive letter before them.

All the specimens to which no other name is attached, or no other source indicated, were collected by J. Beete Jukes.

PART I.

A SMALL COLLECTION OF SUCH OF THE MOST COMMON MINERALS AS ARE THE GENERAL CONSTITUENTS OF ROCKS.

Red Numbers. — Name and Locality, &c.

1. Quartz: ordinary vein quartz, compact and opaque, apparently from a vein in granite.
Locality and collector unknown.

2. Quartz: crystalline, glassy.
From the parish of Banagher, Co. Derry.
Collected by Ordnance Survey under General Portlock.

3. K. 347. Quartz: semi-crystalline vein quartz, with strings of green fibrous mica.
Inistiogue, Kilkenny.

4. C. 2974. Quartz: crystalline, amethystine quartz, part of a large mass, probably from a vein.
Loose block, near Shanagolden, Co. Limerick.
Collected by G. H. Kinahan.

Red Numbers. — Name and Locality, &c.

5. Vacant.

K. 346.

6. Quartz: in small bunches of radiating crystals, coloured by iron.
Cronroe Wood, near Ashford, Co. Wicklow.
Collected by A. Wyley.

7. Quartz: pebble of agate, formed of layers of quartz coloured red by iron or manganese, enclosing uncoloured crystalline quartz.
(?) Purchased from Tennant.

8. Quartz: pebble of jasper (a compact form of quartz, coloured by iron or manganese, or other mineral), containing a nest of uncoloured crystalline quartz.
(?) Purchased from Tennant.

[Some of the simpler compounds of silica with magnesia, such as Steatite or Soapstone, Talc, and Serpentine, should come in here. Their places are temporarily filled by specimens from the Krantz collection, of which the catalogue is given further on.]

9. Augite, or pyroxene: crystallized common augite in basalt.
Purchased from Tennant.
Augite is a compound of silicate of magnesia and silicate of lime.

[Hornblende (or amphibole) should come here. Its place is filled by a crystal of the mineral from the Krantz collection.]

10. Andalusite (a silicate of alumina, generally with other mixtures). Mingled with margarodite mica and decomposing crystals of feldspar.
From Tomduff, Co. Carlow.
Collected by Professor Oldham.

11. Feldspar; Labradorite (or lime feldspar).
Purchased from Tennant.

12. Feldspar; Albite (or soda feldspar).
From the granite of the Mourne mountains.
Collected by —— ?

13. Feldspar (Adularia).
From the parish of Hollyhill, Co. Tyrone.
Collected by the Ordnance Survey.

14. Swedish feldspar; ? Orthoclase or potash feldspar.
Purchased from Tennant.

15. Vacant.
Orthoclase feldspar. } Two specimens from the Krantz collection.
Oligoclase feldspar. }

16. Thomsonite, a Zeolite or hydrated feldspar.
Purchased from Tennant.

Red Numbers. | Name and Locality, &c.

17. Stilbite, a Zeolite or hydrated feldspar.
Said to have come from the interior of India.
Collector unknown.

18. Mica, crystallized, apparently from a quartz vein traversing mica schist.
Purchased from Tennant.

19. Muscovite mica, from Siberia, large plate.
Purchased from Tennant.

[Chlorite with crystal of Epidote, transferred from the Krantz collection.]

[Numbers 20 to 26 reserved for future specimens.]

27. Calcite (carbonate of lime).
From a vein in a quarry near Quarry Lodge, Co. Kerry.
Collected by G. V. DuNoyer.

28.–32. Calcite, as above.*
From veins in the limestone near Mallow, Co. Cork.
Collected by G. V. DuNoyer.

33. Iceland spar, or transparent Calcite (carbonate of lime), showing its doubly refracting power.
Purchased from Tennant.

34. Arragonite (carbonate of lime, which assumes a crystalline form different from that of Calcite).
From a quarry near Edenderry, King's Co.
Collected by G. V. DuNoyer.

35. Dolomite or Bitter spar, Pearl spar, &c.
From veins of dolomite, or magnesian limestone, in the Carboniferous limestone near Malahide, Co. Dublin.

36. Selenite (sulphate of lime, or crystallized gypsum).
From the clay near London.
Purchased from Tennant.

37. Calcite: Quarry W. of Edenderry. Large block.
Collected by G. V. DuNoyer.

44 to 52. Artificial silicates or slags.
From the Glass Works of Mr. Arthur, of Ringsend, and presented by him.

[Numbers 53 to 59 reserved for future specimens.]

* Here and elsewhere through the collection a few more duplicates are retained than are absolutely necessary, in order that they may be replaced by other more desirable specimens of the same class, according as opportunities occur for collecting them.

IGNEOUS ROCKS.

LAVAS.

Red Numbers. Name and Locality, &c.

60. Trachyte, porphyritic.
N. 1163. From the Roc de Cacadogne, Mont Dor, Auvergne. Large crystals of glassy feldspar, in a semi-vesicular crystalline base. Looks almost like a granite at a distance.

61. Trachyte, porphyritic.
N. 1155. From the Pic de Sancy (summit of Mont Dor), Auvergne. Crystals of glassy feldspar scattered through a pale gray very crystalline base.

62. Trachyte, porphyritic.
N. 1157. From the Pic de Sancy (summit of Mont Dor), Auvergne. Crystals of glassy feldspar scattered through a pale gray very crystalline base.

63. Trachyte, vesicular.
N. 1150. From the Roc de Cruzau, Mont Dor, Auvergne. Dark gray, micro-crystalline, slightly vesicular.

64. Trachyte, vesicular.
N. 1145. From the Roc de Cruzau, Mont Dor, Auvergne. Dark gray, micro-crystalline, slightly vesicular.

65. Trachyte.
N. 1142. From the Roc de Cruzau, Mont Dor, Auvergne. Scattered crystals of white glassy feldspar in a darker compact base, having some curious concentric bands.

66. Trachyte.
N. 1151. From the crags just over the Baths of Mont Dor, like 65, but the base more vesicular.

67. Trachyte.
N. 1140. From the plateau N. of the Roc de Cruzau, enclosing fragments of another variety of Trachyte.

68. Trachyte: nearly compact, but with coloured lines and flattened vesicles showing the lines of flow.
N. 1187. From the Crête d'Angousse, Puy Pariou, near Puy de Dome, Auvergne.

69. Trachyte: dark gray compact, splitting into slabs, used for roofing.
N. 1137. From a quarry to the E. of Querilhe, in the valley of Croix Morande, Mont Dor, Auvergne.

69*a*. Trachyte, splitting into thin slabs.
N. 1138. Querilhe, Mont Dor, Auvergne.

70. Trachyte: splitting into thin slabs.
N. 1144. From the end of the Plateau, N. of the Roc de Cruzau, Mont Dor.

71. Trachyte: pale gray, micro-crystalline.
N. 1179. From the road between Le Puy en Velay and Issingeaux.

Red Numbers.	Name and Locality, &c.

72. Trachyte : millstone-trachyte.
K. 284. From the Laacher See.
From a stonecutter's shop in Cologne.

73. Trachyte : a congeries of beautiful crystals of glassy feldspar.
5. From blocks on the Pumice Plains, at the foot of the cone of the Pico del Teyde, Teneriffe.

74. Trachyte : pale gray and very crystalline (a rounded fragment of ? Andesite embedded in lava).
15. From the small island of Trinidad, in S. Atlantic (not the West Indian Trinidad).

74*a*. Trachytic lava.
12. From little island of Trinidad.

74*b*. Trachytic lava.
14. From little island of Trinidad.

74*c*. Lava: compact, greenish gray, with crystals of glassy feldspar.
10. From little island of Trinidad.

75. Trachyte : very crystalline, having roundish crystalline granules of glassy feldspar and long crystals of a black mineral like hornblende (? Augite).
2407. From the side of the road ascending from Batu to Antang, over the connecting ridge between Arjuno and Kawi, Island of Java.

76. Trachyte : very crystalline, having roundish crystalline granules of glassy feldspar and long crystals of a black mineral like hornblende (? Augite).
2405. From the side of the road ascending from Batu to Antang, over the connecting ridge between Arjuno and Kawi, Island of Java.

77. Trachyte : dark red and rather earthy, with scattered crystals and nests of crystals of glassy feldspar.
2401. From a block lying on the Laut pasir (or Sand Sea), in the interior of the old crater of the Bromo, Island of Java. The blocks had apparently fallen from the great precipitous wall surrounding the crater.

78. Trachyte : gray, with scattered crystals of glassy feldspar, and many small crystals of iron pyrites.
2421. From rounded blocks embedded in tuff or "ash," near Klakka, Island of Java.

79. Trachyte ? a nearly black base of a sugary texture, with numerous large distinct crystals of glassy feldspar scattered about it ; the most common rock in the ridge between Tosari and Pakis.
2419. Collected two miles S. of Kobonsari, Island of Java.

80. Trachyte : black, very vesicular, with glassy feldspar.
2412. From the bed of the brook near the "Passangerang" (or guest house) of Malang, Island of Java.

Red Numbers.	Name and Locality, &c.
81. N. 2406.	Same as 75 and 76.
82.	Domite: with scattered plates of black mica. From near the summit of Puy de Dome, Auvergne.
83. N. 1189.	Domite. From the Grand Sarcoui, near Puy de Dome, Auvergne.
84. N. 1191.	Domite. From the Grand Sarcoui, near Puy de Dome, Auvergne.
85 & 86. N. 1188.	Domite, decomposed. N. side of Puy de Dome.
87.	Pumice: the filamentous form of trachyte. Purchased.
88.	Pumice: the filamentous form of trachyte. Purchased.
89. N. 1167.	Clinkstone? (or compact platy gray trachyte, with flat tabular crystals of glassy feldspar). Roche Sanadoire, N. of Mont Dor, Auvergne. Mr. Poulet Scrope describes that hill as made of Phonolite or Clinkstone.*
90. N. 1181.	Clinkstone. Road between Le Puy en Velay and Issingeaux.
91. N. 1182.	Clinkstone. Road between Le Puy en Velay and Issingeaux.
92. 93. 94. 95.	Vacant.
96. 39.	Doleritic lava. From the Island of St. Paul's, in the middle of the S. Indian Ocean.
97. 40.	Doleritic lava, very vesicular. The vesicles sometimes coated internally by a white substance, making the rock amygdaloidal. From St. Paul's Island, Indian Ocean.
98.	Vacant.
99. N. 1185.	Vesicular lava, of a red colour. From near summit of Puy Pariou, Auvergne.
100. N. 1184.	Vesicular lava, of a red colour. Summit of Puy Pariou, Auvergne.
101.	Vacant.

* The correct definition of Clinkstone is a hydrated trachyte. The Rev. Professor Haughton having examined and analyzed fragments of these specimens, found that they did not come within that definition.

Red Numbers. Name and Locality, &c.

102. Lava.
N. 1186. Of Puy Chaluzet, Pont Gibaud, Auvergne.

103. Trachy-dolerite?
N. 1165. From near the bridge of Sailhens, Auvergne, part of the stream proceeding from the Puy Tartaret. Upper part of the stream, and therefore vesicular.

104. Trachy-dolerite.
From near the bridge of Sailhens, Auvergne, but taken from about five feet beneath the surface, and therefore compact.

105. Doleritic? lava, with olivine?
N. 1171. From above Arsac, S. of Le Puy en Velay.

106.

107. Doleritic lava: vesicular, with olivine?
K. 282. From volcano of Facherhöhe, Bertrich, Lower Eifel.

108. Doleritic lava: vesicular and amygdaloidal.
From near Geelong, Victoria.

109. Decomposed lava, or volcanic ash.
3710. From Melbourne, Victoria.

VOLCANIC TUFF OR ASH.

109*a*. Trachytic ash, or tuff.
N. 1154. One of the hardest or firmest pieces that could be got in the valley of Croix Morande, Mont Dor, Auvergne.

110. Volcanic ash, doleritic.
N. 1172. From the Rocher de Corneille, Le Puy en Velay.

111. Volcanic ash, doleritic.
K. 306. Falkenlei, Bertrich, Lower Eifel.

BASALTIC TUFF OR ASH.

112. Basaltic ash.
K. 427. From the so-called red ochre beds, in the cliffs near the Giant's Causeway, Co. Antrim.

113. Basaltic ash.
K. 430. From the cliffs near the Giant's Causeway, Co. Antrim.

114. Ferruginous concretions in the red ochre beds of 112, made up of pisolitic iron ore, in red clay.
K. 433.

115. Clayey basaltic ash, or wacke: the consolidated powder of basaltic lava.
K. 434. Near the hills called the Stoocauns, at foot of the cliff near the Giant's Causeway, Co. Antrim.

115*a*. Basaltic ash.
K. 480. From Cawney Hill, Rowley Hill, S. Staffordshire.

115*b*. Basaltic ash.
K. 478. From beneath the basalt of Cawney Hill, Rowley Hill, S. Staffordshire.

Red Numbers.	Name and Locality, &c.

115*c*. Basaltic ash, with carbonate of lime.
K. 479. From beneath the basalt of Cawney Hill, Rowley Hill, S. Staffordshire.

115*d*. Basaltic ash.
K. 223. From summit of Arthur's Seat, Edinburgh.

BASALTS.

[The Basalts and the Pitchstones may be considered either as lavas or traps, according to circumstances; the Basalts being often hydrated Dolerite, and the Pitchstones having a relation to Obsidian.]

116. Basalt.
N. 4894. From summit of Arthur's Seat, Edinburgh. A tertiary lava.
Collected by F. J. Foot.

116*a*. Basalt.
N. 298. From summit of Arthur's Seat, part of a tertiary lava.

117. Basalt.
K. 230. From summit of Arthur's Seat, Edinburgh.

118. Basaltic lava, with magnetic iron.
N. 927. From summit of Arthur's Seat, Edinburgh.

119. Basaltic lava, with magnetic iron.
N. 926. From summit of Arthur's Seat, Edinburgh.

120. Basalt.
N. 4895. From summit of Arthur's Seat, Edinburgh.
Collected by F. J. Foot.

121. Basalt.
From N. of Ireland.
Collected by Ordnance Survey.

122. Vacant.

123. Basalt: the common kind of basalt of the Giant's Causeway, &c.
K. 436. From the foot of the cliff just at back of the Causeway.

123*a*. Crystalline basalt (or Greenstone).
K. 437. From a dyke running between the Honeycomb and the Grand Causeway.

124. Basalt.
From N. of Ireland.
From Ordnance Survey.

124*a*. Basalt.
K. 473. From Coxe's Rough, Rowley Hill, S. Staffordshire.

125. Vesicular trap.
From Brent Tor, Devonshire.

126. Vesicular trap.
From Brent Tor, Devonshire.

127. Basalt: ball showing internal concentric spheroidal structure.
Believed to be from the N. of Ireland.
Collected by —— ?

Red Numbers.	Name and Locality, &c.

128. Basalt: ball showing internal concentric spheroidal structure.
Believed to come from N. of Ireland.
Collected by —— ?

129. Basalt: ball showing internal concentric spheroidal structure.
Believed to come from the N. of Ireland.
Collected by —— ?

130. Basalt: small prism.
From Co. Antrim.
Presented by Dr. Sullivan.

131. Basalt: amorphous and amygdaloidal.
K. 438. From the headland just east of the Giant's Causeway.

132. Basalt: amorphous and amygdaloidal.
From Magilligan, Co. Derry.
Collected by Ordnance Survey.

133. Basalt: amorphous and amygdaloidal.
From Giant's Causeway.
Collected by Ordnance Survey.

134. Basalt: amorphous and amygdaloidal.
From Giant's Causeway.
Collected by Ordnance Survey.

134*a*. Basalt, or whinstone: large block.
From Collin well, Belfast.
Collected by A. Wyley.

PITCHSTONES.

135. Pitchstone.
K. 250. From dyke in granite.
S. of Cior Mor, Isle of Aran.
Collected by F. J. Foot.

136. Pitchstone.
K. 254. From Brodick, Aran, from dyke in bed of sandstone (Carboniferous).
Collected by F. J. Foot.

137. Pitchstone.
K. 255. From dyke in bed of sandstone (Carboniferous).
At School-house, Brodick, Aran.
Collected by F. J. Foot.

138. Stony Pitchstone: with pisolitic concretions.
K. 258. From dykes in sandstone (Carboniferous).
Near Corriegills, Aran.
Collected by F. J. Foot.

139. Pitchstone.
From Island of Skye.
Presented by Dr. MacDonald, of St. Andrew's.

140. Pitchstone.
From Island of Skye.
Presented by Dr. MacDonald, of St. Andrew's.

Red Numbers.	Name and Locality, &c.

141. Pitchstone: assuming a tabular or laminated form.
Believed to come from the road between Newry and Banbridge.
Collector unknown.

[Numbers 142 to 147 reserved for future specimens.]

TRAPPEAN ROCKS.

148. Felstone: gray, compact, with weathered margin of $\frac{1}{8}$-inch deep.
86.
From townland of Kilpatrick, S. of Redcross, Co. Wicklow.
Collected by Dr. W. K. Sullivan.

149. Felstone: gray, compact, with weathered surface.
132. From near Brittas Mill, S. of Redcross, Co. Wicklow.
Collected by Dr. W. K. Sullivan.

150. Felstone: gray, mottled smoky brown.
119. From Tonlegee, N.E. of Redcross, Co. Wicklow.
Collected by Dr. W. K. Sullivan.

151. Felstone: distinctly porphyritic, with crystals of white feldspar in a very dark gray compact base.
Kilmurry N., Redcross, Co. Wicklow.
Collected by Professor Oldham.

152. Felstone: dark gray, compact, or micro-crystalline, with
N. 3025. weathered surface band $\frac{5}{8}$-inch deep.
Summit of Arklow Rock.

153. Felstone: pale gray, with brown surface band of weather-
N. 3028. ing $\frac{1}{2}$-inch deep, traversed by dark parallel lines (showing "striæ of fusion," or lines of flow?)
Arklow Rock, Co. Wicklow.

154. Felstone: gray, crystalline-granular.
9. From a dyke behind Glenart Castle, near Arklow, Co. Wicklow.
Collected by Dr. W. K. Sullivan.

155. Felstone: dark gray, having a distinct "grain," or parallel
N. 3014. lines of slightly varying colour, with scattered crystals of feldspar arranged parallel to the "grain."
Quarry on the beach, Arklow Rock, Co. Wicklow.

156. Felstone?: dark gray, micro-crystalline.
94. N.E. of Rock-view, three miles N. of Arklow, Co. Wicklow.
Collected by Dr. W. K. Sullivan.

157. Felstone: rather crystalline, having a cross hackly fracture,
50. or else being affected by a rude cleavage.
E. side of Ballycoog Ford, N.W. of Wooden Bridge, Co. Wicklow.
Collected by Dr. W. K. Sullivan.

158. Felstone: traversed in all directions by concealed joints.
183. The Bell Rock, Ovoca, Wicklow.

Red Numbers.	Name and Locality, &c.
159. 241.	Felstone: dark gray, crystalline-granular. From Tullylusk, S.E. of Rathdrum, Co. Wicklow.
160. N. 1117.	Felstone: nearly white, micro-crystalline. Ballinacor Hill (S. side), W. of Rathdrum, Co. Wicklow.
161. 117.	Felstone: gray, compact. Mount Lusk, near Rathdrum, Co. Wicklow.
162. M. 2484.	Felstone: gray, compact, contemporaneous, showing "lines of fusion?" or "grain." Contains little veins of galena and blende. Kilfarrasy Strand, Co. Waterford. Collected by W. L. Willson.
163. M. 2458.	Felstone: greenish, compact. Shore E. of Annestown, Co. Waterford. Collected by W. L. Willson.
164. M. 2437.	Felstone: greenish, micro-crystalline, believed to be intrusive. Garrarus Strand, Co. Waterford. Collected by W. L. Willson.
165. M. 2450.	Felstone: gray, compact, contains crystals of carbonate of lime. From a dyke; Garrarus Strand, Co. Waterford. Collected by W. L. Willson.
166. M. 2459.	Felstone: pale greenish gray, compact; believed to be either contemporaneous trap or altered ash. Co. Waterford, Kilfarrasy Strand. Collected by W. S. Willson.
167.	Felstone: pale gray, micro-crystalline, with weathered surface ¼-inch deep. From a point three miles S.W. of Gorey, Co. Wexford. Collected by Professor Oldham.
168. N. 911.	Felstone: gray, with hackly fracture. Carrickmastra Hill, between Enniscorthy and New Ross, Co. Wexford.
169. J. 800, n.	Felstone: very pale gray, with dark specks, micro-crystalline. Cherry Orchard, near Enniscorthy, Co. Wexford.
170.	Felstone: very pale gray, with hackly fracture. From Clogher Head, Dingle Promontory, Co. Kerry. Collected by G. V. DuNoyer.
171.	Felstone: dull purple, small crystals of feldspar in compact base. From the neighbourhood of Clogher Head, Dingle Promontory. Collected by G. V. DuNoyer.
172.	Felstone: ? (or greenstone.) Green, mottled with red, compact. From a dyke in the Dunquin River, Dingle Promontory, Co. Kerry. Collected by G. V. DuNoyer.

Red Numbers.	Name and Locality, &c.

173. Felstone: with wavy lines of flow surrounding knots of compact rock, partly decomposed.
Clogher Head, Dingle Promontory, Co. Kerry.
Collected by G. V. DuNoyer.

174. N. 1494. Felstone: dark gray, with tortuous "lines of flow."
Benaunmore, Loch Guitane, Killarney.
Collected by G. V. DuNoyer.

175. N. 1522. Felstone: dark gray, becoming porphyritic, from scattered crystals of white feldspar.
Benaunmore, near Killarney.
Collected by G. V. DuNoyer.

176. N. 1438. Felstone: partly decomposed, so as to exhibit tortuous lines of flow more distinctly.
From Benaunmore, near Killarney.
Collected by G. V. DuNoyer.

177. N. 1329. Felstone: dark gray, with parallel lines of flow.
Benaunmore, S. of Loch Guitane, Killarney.
Collected by G. V. DuNoyer.

178. C. 4932. Felstone: gray, compact.
S.W. of Knockanallig Mountain, Bear Island, Co. Cork.
Collected by G. H. Kinahan.

179. C. 4465. Felstone: ? platy, compact, pale gray, iron-stained, calcareous, vesicular; vesicles full of carbonate of lime.
From a dyke near Fair Head, W. side of Bear Haven, Bantry Bay, Co. Cork.
Collected by G. H. Kinahan.

180. C. 4466. Felstone: ? granular, greenish purple, calcareous.
Fair Head, Bantry Bay.
Collected by G. H. Kinahan.

181. C. 4931. Felstone: light gray, vesicular, with brown ferruginous spots.
Bear Island, Bantry, Co. Cork.
Collected by G. H. Kinahan.

182. Felstone: granular-crystalline. (The Gray beds) (? passing into a kind of greenstone), said to be intrusive.
Pen-y-Graig, W. of Arenig, Merionethshire.
Collected by A. R. C. Selwyn.

183. Felstone: gray, compact, rather platy base, with scattered crystals of feldspar.
From Moelddu, N. end of the Aran range, Merionethshire.
Collected by A. R. C. Selwyn.

184. Felstone: nodular, forming a mass of roundish concretions.
Glyderfawr, Llanberis, N. Wales.
Collected by Professor A. C. Ramsay.

185. Felstone: ? dark gray, intrusive among ash beds.
Between Penmaen and Carigllysog, N. Wales.
Collected by A. R. C. Selwyn.

Red Numbers. Name and Locality, &c.

186. Felstone: porphyritic, green compact base, with roundish amygdaloidal lumps of crystalline quartz.
N. 1651. From the promontory of Kilbride, S.W. corner of Lough Mask, Co. Galway.

187. Felstone: ? (labelled "eurite or compact feldspar.")
Templepatrick Parish, Co. Antrim.
Collected by Ordnance Survey.

188. Felstone: very dark compact base, looking like black chert, with scattered crystals of feldspar.
638. Sir C. Hardy's Islands, N.E. Coast of Australia.

189. Vacant.

190. Greenstone: fine grained, small crystals of hornblende and feldspar.
114 Tonlegee, N.E. of Redcross, Co. Wicklow.
Collected by Dr. W. K. Sullivan.

191. Greenstone: fine grained, small crystals of hornblende and feldspar.
120. Tonlegee, N.E. of Redcross, Co. Wicklow.
Collected by Dr. W. K. Sullivan.

192. Greenstone: crystalline-granular.
K. 410. Near Redcross, Co. Wicklow.

193. Greenstone: white, mottled with green.
K. 411. From near West Aston, Co. Wicklow.

194. Greenstone: very crystalline, with much mica.
Dauganstown, S.E. of Rathdrum, Co. Wicklow.
Collected by Professor Oldham.

195. Greenstone: dark green, compact.
240. Tullylusk, S.E. of Rathdrum, Co. Wicklow.

196. Greenstone: full of plates of bronze mica.
Ticlash, Rathdrum, Co. Wicklow.

197. Greenstone: with mica.
811. Carrigmore, between Rathdrum and Wicklow.

198. Greenstone: micaceous.
814. Carrigmore, between Rathdrum and Wicklow.

199. Hornblende rock.
K. 839. From top of ridge between the two valleys, Seven Churches, Co. Wicklow.

200. Greenstone: crystalline.
N. 3004. Western flank of the hill called Rock Big, Arklow, Co. Wicklow.

201. Greenstone: fine grained.
N. 3005. Rock Big, E. side, Arklow Rock, Co. Wicklow.

201*a*. Greenstone: fine grained.
N. 3009. Rock Big, East side, Arklow.

Red Numbers. Name and Locality, &c.

202. Greenstone : fine grained.
Arklow Rock, W. flank, Co. Wicklow.

203. Greenstone : highly crystalline, near elvan dyke.
N. 2990. Rock Little, Arklow.

204. Greenstone ?
J. 892. S. of Roundwood, Co. Wicklow.

204A. Greenstone : very hard and crystalline, one mile S.W. of
K. 338. Ballyneale, S. of Inistiogue, Co. Kilkenny.

205. Greenstone : very crystalline.
Ballythomas, near Croaghan Kinshela, Co. Wexford.
Collected by Professor Oldham.

206. Greenstone : crystalline, with highly crystalline vein.
Ballythomas, near Croaghan Kinshela, Co. Wexford.
Collected by Professor Oldham.

207. Greenstone : green patches as if embedded in a white rock, which, however, is believed to be merely veins of white rock in the greenstone.
Annagh Gap, near Croaghan Kinshela, Co. Wexford.
Collected by Professor Oldham.

207*a*. Greenstone : green patches as if embedded in white rock. Large block.
Annagh Gap, near Croaghan Kinshela, Co. Wexford.
Collected by Professor Oldham.

208. Greenstone :? porphyritic, excessively crystalline.
Carrig, near Croaghan Kinshela, Co. Wexford.
Collected by Professor Oldham.

209. Greenstone :? apparently consisting of fragments of a green rock embedded in a white rock (see No. 207).
Annagh Gap, S.W. of Croaghan Kinshela, Co. Wexford.

210. Greenstone.
J. 786, n. From near Enniscorthy, Co. Wexford.

211. Greenstone :? hornblendic constituent in patches, in white feldspar vein.
Ballybrazil, S. of New Ross, Co. Wexford.

212. Greenstone : with vein of red jasper.
Portraine Shore, Co. Dublin.
Collected by G. V. DuNoyer.

213. Greenstone : porphyritic, with scattered crystals of white
N. 1263. feldspar.
Ballinascorney Gap, Co. Dublin.

214. Greenstone : completely porphyritic, pale green crystals
N. 1262. scattered in dark green base.
Lambay Island, Co. Dublin.
Presented by Lord Talbot de Malahide.

Red Numbers. Name and Locality, &c.

215. Greenstone : highly crystalline, dark hornblendic crystals in
N. 909. base of white feldspar.
Rochestown, near Waterford, Co. Kilkenny.

216. Greenstone : coarsely crystalline.
N. 1918. In bosses apparently surrounded by granite, four and a-half miles S. of Thomastown, Co. Kilkenny.

217. Greenstone.
K. 344 From blocks near the top of the hill, apparently surrounded by granite, in the townland of Cappagh, on the W. side of the Glenpipe Valley, four and a-half miles S. of Thomastown, Co. Kilkenny.

218. Greenstone.
K. 342. From blocks near the top of the hill, apparently surrounded by granite, in the townland of Cappagh, on the W. side of the Glenpipe Valley, four and a-half miles S. of Thomastown, Co. Kilkenny.

219. Greenstone.
K. 342. From blocks near the top of the hill, apparently surrounded by granite, in the townland of Cappagh, on the W. side of the Glenpipe Valley, four and a-half miles S. of Thomastown, Co. Kilkenny.

220. Greenstone : porphyritic, green crystals in dark compact base.
From the top of Grange Common hill, near Kildare.
Collected by G. V. DuNoyer.

221. Greenstone : porphyritic, green crystals in dark compact base.
From Hill of Allan, near Kildare.
Collected by G. V. DuNoyer.

222. Greenstone : dark finely granular crystalline base, with amygdaloidal crystalline lumps of zeolite.
From a dyke near Dunquin, Dingle Promontory, Co. Kerry.
Collected by G. V. DuNoyer.

223. Greenstone : fine grained, dull green.
Beginish Island, between Dunquin and the Blasket Islands, Co. Kerry.
Collected by G. V. DuNoyer.

224. Greenstone : very crystalline.
N. 1090. Michills, N. of Bandon, Co. Cork.

225. Greenstone :? a red feldspathic porphyry, with numerous distinct crystals of hornblende.
Clondermot, Co. Derry.
Collected by Ordnance Survey.

226. Greenstone syenite : containing distinct crystals of hornblende, feldspar, and quartz.
Craigballybarty, Kildress, Co. Tyrone.
Collected by Ordnance Survey.

Red Numbers.	Name and Locality, &c.
227.	Greenstone: ? porphyritic. Donaghmore, Grahamsland, Donegal. Collected by Ordnance Survey.
228.	Greenstone:? (somewhat resembling No. 208), termed Anorthite syenite by Professor Haughton, in accordance with the use of the word Syenite, adopted by Nauman and others. From Carlingford Mountains. Presented by Rev. Professor Haughton.
229. N. 1706.	Greenstone, or other basic porphyry. From N. side of Killery Harbour, Co. Mayo.
230.	Greenstone: part of a rudely hexagonal column. Very crystalline. Locality and collector unknown.
231.	Greenstone: highly crystalline aggregate of feldspar and augite. Portrush, Co. Antrim. Collected by Ordnance Survey.
231*a*. K. 441.	Greenstone: dark gray, with black flakes. Very crystalline. Summit of cliffs W. of Fairhead, near Ballycastle, Co. Antrim.
231*b*. K. 419.	Greenstone: nearly black. Very crystalline glittering rock, cutting through and altering the Lias. Portrush, Antrim.
231*c*.	Greenstone: excessively crystalline, black hornblende and white feldspar, with zeolitic balls. Portrush, Co. Antrim.
232. K. 224.	Greenstone, or felstone porphyry: dark purplish gray, with distinct crystals of feldspar. St. Leonard's Crags, Edinburgh.
233. N. 4880.	Greenstone: highly crystalline. Salisbury Crags, Edinburgh. Collected by F. J. Foot.
234. N. 925.	Greenstone: dark gray, crystalline; cuts through and runs over a Carboniferous sandstone. Salisbury Crags, Edinburgh.
235. N. 4884.	Greenstone, compact (or Basalt). St. Arthur's, St. Anthony's Chapel, Edinburgh. Collected by F. J. Foot.
236. N. 4885.	Greenstone: porphyry. St. Anthony's Chapel, Edinburgh. Collected by F. J. Foot.
237. N. 4899.	Greenstone: dark gray, amygdaloidal. Pentland Hills, Edinburgh. Collected by F. J. Foot.

Red Numbers.	Name and Locality, &c.

238. Greenstone? : or highly crystalline basalt, with olivine? &c.
N. 4893. S.E. summit of Arthur's Seat, Edinburgh.
Collected by F. J. Foot.

239. Greenstone : dark gray crystalline, cuts through a Carboniferous sandstone.
N. 4832. Salisbury Crags, Edinburgh.
Collected by F. J. Foot.

240. Greenstone : porphyritic, white crystals of feldspar in dark compact base.
K. 226. From E. side of Hunter's Bog, near Arthur's Seat, Edinburgh.

241. Felstone : ? porphyritic and amygdaloidal, contemporaneous with Carboniferous rocks.
K. 223. N. of S. side of Dunsapy Lough, first slope.

242. Greenstone : common, crystalline.
Barn Hill, near Newtown Linford, Charnwood Forest, Leicestershire.
From Geological Survey of Great Britain.

243. Felstone ? porphyry.
Charnwood Forest, Leicestershire.

244. Greenstone : mottled black, red, and green.
Stantonfield, Charnwood Forest.
From Geological Survey of Great Britain.

245. Greenstone : dark green, mottled with flesh colour, said to pass into syenite, but no quartz visible in this specimen.
Bradgate Park, Charnwood Forest, Leicestershire.
From Geological Survey of Great Britain.

246. Greenstone, ? or Felstone : ? micro-crystalline.
Grooby, S.E. end of Charnwood Forest.
From Geological Survey of Great Britain.

247. Greenstone (called Toadstone) : greenish gray, mottled, with amygdaloidal concretions.
K. 231. Bonsaldale, near Matlock, Derbyshire.

248. Greenstone (called Toadstone).
K. 232. Bonsaldale, near Matlock, Derbyshire.

249. Greenstone.
Caer Caradoc, Church Stretton.
From Geological Survey of Great Britain.

250. Greenstone : ? porphyritic, intrusive into Cambrian Rocks.
Moel Gron, N. of Rhobell-fawr, Merionethshire.
Collected by A. R. C. Selwyn.

251. Greenstone : ? brown, porphyritic, and amygdaloidal.
N. 1467. Charfield, Tortworth, Gloucestershire.

252. Greenstone : porphyritic, compact.
N. 1470. Damory Park, Tortworth, Gloucestershire.

Red Numbers. | Name and Locality, &c.

253. Greenstone : ? brown, porphyritic, and amygdaloidal.
N. 1468. Charfield, Tortworth, Gloucestershire.

254. "White rock" trap (vein proceeding from greenstone) with altered coal vein included in it.
S. Staffordshire Coal field.

255. "White rock" trap (vein from greenstone). Dyke in railway cutting.
K. 472. Landywood, near Bloxwich, S. Staffordshire.

256. Greenstone : amygdaloidal, with zeolite.
K. 468. From New Invention near Wolverhampton, S. Staffordshire.

257. Greenstone : amygdaloidal, with zeolites.
K. 464. Neachell's, near Wolverhampton, S. Staffordshire.

258. Greenstone : amygdaloidal with zeolites.
K. 465. Neachell's, near Wolverhampton, S. Staffordshire.

[Numbers 259 and 260 reserved for future specimens.]

LARGE BLOCKS.

261. Greenstone: dyke cutting through dark limestone, pieces of which are seen on each side of the vein of greenstone or whinstone.
From quarries near Dundalk.
Collected by A. Wyley.

262. Greenstone: fine grained.
1101. Large block.
Baleese Brook, Rathdrum, Wicklow.

263. Felstone : dark gray, crystalline.
Tara Hill, N.E. of Gorey, Co. Wexford.
Collected by Professor Oldham.

264. Felstone : column, rudely hexagonal.
From the Cliffs of Knockmahon, Co. Waterford.
Collected or presented by —— ?

265. Felstone : column, rudely pentagonal.
Co. Waterford.
Collected by —— ?

[The above five specimens are on the ground tier.]

SMALL SPECIAL SET OF AUSTRALIAN LAVAS AND TRAPS PLACED HERE FOR COMPARISON.

266. Lava : vesicular, filled with nests of decomposed zeolite
8118. (? natrolite). Surrounded by a coral reef.
Bramble Key, Torres Straits.

267. Lump of coral limestone from the breccia associated with
2803. the lavas, of which 268 and 269 are specimens apparently altered in same way as some of Antrim chalk is altered ; see No. 736.
S.W. side of Darnley Island, Torres Straits.

Red Numbers. Name and Locality, &c.

268. Dark augitic? lava: vesicular.
2805. From near N.W. point of Darnley Island, Torres Straits.

269. Dark augitic? lava: vesicular.
2802. From near N.W. point of Darnley Island, Torres Straits.

270. Vesicular lava: rounded pebble.
2943. From volcanic conglomerate, Wyer Island, near Murray's Island, Torres Straits.

271. Vesicular lava: rounded pebble.
2940. From conglomerate, Wyer Island, near Murray's Island, Torres Straits.

272. Volcanic tuff (or ash), specimen of the finer beds.
[illegible] From Maer or Murray Island, Torres Straits.

273. Lava pebble: embedded in the volcanic conglomerate or ash, in which 267 was also found.
2804. N.W. side of Darnley Island, Torres Straits.

274. Felstone porphyry: with scattered roundish crystalline lumps of quartz.
York Island, Cape York, Torres Straits.

275. Trap rock: micro-crystalline.
712. From N.E. Coast of Australia.

276. Felstone porphyry: compact gray base, with crystals of fleshy-coloured feldspar and roundish crystalline lumps of quartz.
No Go Island, Endeavour Straits.

277. Felstone: gray, highly crystalline (would be called feldspar porphyry).
283.? N.E. Coast of Australia. Exact locality doubtful.

278. Felstone: porphyritic (feldspar porphyry, quartziferous).
813. A gray compact base, with large scattered crystals of flesh-coloured feldspar, and a few roundish crystalline lumps and grains of quartz.
Mount Adolphus, Torres Straits.

279. Felstone: porphyritic (feldspar porphyry, quartziferous).
815. Gray compact base, with scattered crystals of white feldspar, and a few scattered crystalline lumps of quartz.
Mount Adolphus, Torres Straits.

280. Felstone: porphyritic (feldspar porphyry, quartziferous).
227. Port Bowen, N.E. Coast of Australia. All the surrounding hills seemed formed of this rock.

281. Felstone: dark gray compact base, with large scattered
3564. crystals of glassy-looking feldspar.
Wollongong, N. S. Wales.

282. Felstone: dark gray compact base, with large scattered
3560. crystals of glassy-looking feldspar.
Wollongong, N. S. Wales.

Red Numbers. Name and Locality, &c.

283. Felstone?: or greenstone?: dark gray compact base, with
572. scattered crystals of green feldspar.
No. 1 Island, Cumberland group, N.E. Australia.

284. Trap?: or lava?: gray trachytic looking, highly vesicular. Taken from the part immediately in contact with the upright silicified tree, which was exhibited in the Great Exhibition of 1851.
From Barker's Plains, Tasmania.

285. Trap, or lava: vesicular.
133. Norfolk Bay, Tasmania.

286. Trap, or lava: dark compact.
135. From the Salt Water River, Norfolk Bay, Tasmania.

287. Greenstone: dark gray, micro-crystalline.
136. Norfolk Bay, Tasmania.

TRAPS FROM NEWFOUNDLAND.

288. Hyperite, or Hypersthenite: large crystals of Labradorite and Hypersthene.
Indian Head, St. George's Bay, Newfoundland.

289. Hyperite, or Hypersthenite: large crystals of Labradorite and Hypersthene.
Indian Head, St. George's Bay, Newfoundland.

290. Trap; black, compact, with hexagonal crystals of black mica.
From a dyke traversing granite, Twillingate, N. Coast of Newfoundland.

291. Trap; black, compact, with hexagonal crystals of black mica.
From a dyke traversing granite, Twillingate, N. Coast of Newfoundland.

[Numbers 292 to 297 reserved for future specimens.]

TRAPPEAN ASH.

298. Felstone ash (Bala ash) called by inhabitants, Cerig llwydion, or brown stone.
From a place named Cerig llwydion after the rock, S.W. of Bala, Merionethshire.

299. Felstone ash (Cerig llwydion.)
From Craigyrogof, near Bala, Merionethshire.

300. Felstone ash (Cerig llwydion.)
From the quarries of Y Gelli grin, E. of Bala, Merionethshire.
[The above three specimens are from a widely extended bed, rarely more than ten feet thick, in the gray slates of the Bala series.]

301. Felstone ash.
From beneath the felstone of Yr Alt llwyd, N. Wales.
Collected by Geological Survey of Great Britain.

302. Felstone ash: partly decomposed.
From the bed S. of Garn Brys, near Yspytty Evan, N. Wales.
Collected by Geological Survey of Great Britain.

Red Numbers. Name and Locality, &c.

303. Felstone ash: fine grained, mottled and banded.
Cwm Orthin, near Ffestiniog, N. Wales.
From Geological Survey of Great Britain.

304. Felstone ash: gray (good characteristic specimen.)
From the N. end of the Aran range, S. of Bala Lake, Merionethshire.
From Geological Survey of Great Britain.

305. Felstone ash.
S. of Llanuwchllyn, S. of Bala Lake, Merionethshire.
From Geological Survey of Great Britain.

306. Felstone ash: fine grained, nearly compact.
From Bryn-moel-uchaf, S.W. of Bala.
From Geological Survey of Great Britain.

307. Felstone ash.
From beneath the felstone trap of Moel-lufnant, N. Wales.
From Geological Survey of Great Britain.

308. Trap breccia, or ash (or concretionary trap.)
N. 4900. From Craiglockart-hill, Edinburgh.
Collected by F. J. Foot.

[Numbers 309 to 314 reserved for future specimens.]

315. Felstone ash: weathered and iron stained.
S.W. of Gorey, Co. Wexford.
Collected by Professor Oldham.

316. Felstone ash: undecomposed, gray, flaky, granular.
From S.W. of Gorey, Co. Wexford.
Collected by Professor Oldham.

317. Felstone ash: good characteristic specimen.
J. 787, n. Enniscorthy, Co. Wexford.

317*a*. Felstone ash: cleaved, contains chips of slate in some places.
N. 1406. Ballyvarney, between New Ross and Dunbrody Abbey, Co. Wexford.

318. Felstone ash: decomposed, iron stained, very fine grained.
122. From Timullen, near Rathdrum, Co. Wicklow.

319. Felstone ash: speckled with white, and some dark patches, out of fine granular slate.
49. N. of Coats-bridge, Co. Wicklow.
Collected by Dr. Sullivan.

320. Felstone ash.
74. From near Redcross, Co. Wicklow.
Collected by Dr. Sullivan.

321. Ash: porphyritic, with pebble; looks at first like a porphyritic felstone.
N. 3020. Arklow, Rock Big, N. slope.

322. Ash: porphyritic, with quartz pebble; looks at first like a porphyritic felstone.
N. 3018. Rock Big, N. slope, Arklow.

Red Numbers. Name and Locality, &c.

323. Ash: brecciated; like a porphyry.
N. 3016. Beach Quarries, Arklow Head.

323*a*. Brecciated ash or felstone, with angular concretions.
N. 3015. Beach Quarry, Arklow, Co. Wicklow.

324. Ash: porphyritic looking, passing into a conglomerate.
N. 3023. Rock Big, N. slope, Arklow.

325. Ash: porphyritic looking, passing into a conglomerate.
N. 3021. Rock Big, Arklow.

326. Porphyritic ash.
N. 3019. Rock Big, Arklow.

327. Porphyritic ash; like a porphyry, but with crystals in parallel lines.
N. 3017. Beach Quarries, Arklow Head.

328. Brecciated trappean ash, with rounded and angular pebbles of other rocks.
M. 2433. Kilfarrassy Strand, Co. Waterford.
Collected by W. L. Willson.

329. Brecciated trappean ash.
M. 2460. Shore E. of Annestown, Co. Waterford.
Collected by W. L. Willson.

330. Brecciated trappean ash: green, including white patch.
M. 2457. Kilfarrassy Strand, Co. Waterford.
Collected by W. L. Willson.

331. Brecciated ash: from a dyke or fissure, cutting beds at right angles.
N. 3686. White Ball Head, Bantry Bay, Co. Cork.
Collected by G. H. Kinahan.

332. Brecciated ash: from a dyke or fissure, cutting beds at right angles.
N. 3685. White Ball Head, Bantry Bay, Co. Cork.
Collected by G. H. Kinahan.

333. Felstone ash (decomposed).
Clogher Head, Dingle, Co. Kerry.
Collected by G. V. DuNoyer.

334. Felstone ash: exactly similar to some of those of Leinster and North Wales, but lying in Wenlock rocks.
Ferriter's Cove, Dingle, Co. Kerry.
Collected by G. V. DuNoyer.

335. Felstone ash: very flaky, decomposed, iron stained.
From Wenlock rocks, Ferriter's Cove, Dingle, Co. Kerry.
Collected by G. V. DuNoyer.

336. Brecciated ash: purple and gray.
From near Clogher Head, Dingle, Co. Kerry.
Collected by G. V. DuNoyer.

Red Numbers. Name and Locality, &c.

337. Brecciated ash : dark purple.
From near Clogher Head, Dingle, Co. Kerry.
Collected by G. V. DuNoyer.

338. Felstone ash : with nodular concretionary structure like pisolite.
Clogher Head, Dingle, Co. Kerry.
Collected by G. V. DuNoyer.

339. Felstone ash : with nodular concretionary structure, like pisolite.
Clogher Head, Dingle, Co. Kerry.
Collected by G. V. DuNoyer.

340. Vacant.

341. Felstone ash : with large nodular concretions.
N. 3683. N. slope of Stoompa Ridge, near Killarney.
Collected by G. V. DuNoyer.

342. Felstone ash : jointed, showing nodular concretions in section.
Stoompa Mountain, near Killarney.
Collected by G. V. DuNoyer.

343. Nodule from nodular felstone ash of Stoompa ; open, partly filled with quartz crystals.
Collected by G. V. DuNoyer.

344. Nodule from felstone ash of Rodger's Rock.
Near the head of Glen Flesk, Co. Kerry.
Collected by G. V. DuNoyer.

345. Nodule from felstone ash of Rodger's Rock ; opened to show interior partially filled with crystals of quartz and brown ochre.
Near head of Glen Flesk, Co. Kerry.
Collected by G. V. DuNoyer.

346. Part of large nodule, five inches across, hollow, partially
N. 3681. filled with vein quartz.
From N. side of Stoompa Ridge, near Killarney.

[Numbers 347 to 355 reserved for future specimens.]

356. Trappean ash, (fossiliferous ?)
146. Corner of lane N.E. of Rathdrum, Co. Wicklow.

357. Trappean ash : with concretions of silica and mammillated ferruginous balls.
Corballis, Rathdrum, Co. Wicklow.
Collected by A. Wyley.

358. Trappean ash : with concretions of mammillated ferruginous balls.
Corballis, Rathdrum, Co. Wicklow.
Collected by A. Wyley.

359. Trappean ash : with concretions of mammillated ferruginous
148. balls.
Corballis, Rathdrum, Co. Wicklow.
Collected by A. Wyley.

360. Vacant.

Red Numbers. | Name and Locality, &c.

361. Greenstone ? ash.
59. Baleese Wood, on bank of River Avonmore, Rathdrum, Co. Wicklow.

362. Greenstone ? ash, compact with black flakes.
71. Baleese Wood, Rathdrum, Co. Wicklow.

363. Greenstone ash : dark green, flaky, granular.
62. Baleese Wood, Rathdrum, Co. Wicklow.

364. Pebble of vesicular trap, from conglomerate in ash.
N. 3032. Arklow Rock, S. end, Co. Wicklow.

365. Conglomerate in ash, containing fragments of vesicular trap.
N. 3034. Arklow Rock, S. side, Co. Wicklow.

366. Greenstone ash.
83. From Ballynamona, N.W. of Wooden Bridge, Co. Wicklow.
Collected by Dr. Sullivan.

367. Vacant.

368. Greenstone ash (fine grained).
K. 341. Coolhill, three miles N.E. of Ballyneale, apparently continuation of same bed as that of Ballyneale, Co. Kilkenny.

369. Greenstone ash.
K. 340. A quarter of a mile E.S.E. of Ballyneale, Co. Kilkenny.

370. Greenstone ash, with crystals ? of feldspar.
K. 339. One mile W.S.W. of Ballyneale, Co. Kilkenny.

371. Greenstone ash : green, flaky, with imperfect cleavage.
From under the Martello Tower, S. of the Portrane Shore, Co. Dublin.
Collected by G. V. DuNoyer.

372. Greenstone ash : green and purple.
From under the Martello Tower, S. of the Portrane Shore, Co. Dublin.
Collected by G. V. DuNoyer.

373. Vacant.

374. Greenstone ash : including large worn crystals of hornblende.
N. 1063. Black Ball Head, W. point, Bantry Bay, Co. Cork.

375. Large mass of greenstone ash, including large worn crystals of hornblende. Large block on ground tier.
N. 1081. Black Ball Head, W. point, Bantry Bay, Co. Cork.

376. Trappean ash : sandy, micaceous.
J. 68,n. From the slate quarries of Canreen Hill, Co. Kildare.

377. Trappean ash : brecciated with fragments of feldspar crystals and green patches like serpentine.
S.W. of Enniscorthy, Co. Wexford.
Collected by Professor Oldham.

378. Brecciated ash : pale greenish gray.
S. of Clogher Head, Co. Kerry.
Collected by G. V. DuNoyer.

[Numbers 379 to 384 reserved for future specimens.]

SPECIAL SET OF TRAPS AND ASHES FROM THE LIMERICK TRAPPEAN BASIN.

Red Numbers.	Name and Locality, &c.
385. N. 4943.	Syenite: intrusive; dark, mottled red and green, crystalline mixture of feldspar and hornblende, with occasional granules of quartz. Knock Dirk, two and a-half miles N.E. of Bruff, Co. Limerick.
386. N. 3075.	Felstone? porphyry: intrusive; dark greenish gray, very crystalline, no quartz visible. Knock Dirk, two and a-half miles N.E. of Bruff, Co. Limerick.
387. 1025.	Greenstone?, intrusive; green compact base, with scattered crystals of feldspar and pale brown ferruginous spots; very hard tough rock. Castle Farm, one mile N. of Hospital, Co. Limerick.
388. N. 4973.	Intrusive Trap: pale gray compact earthy looking, with brown specks and brown ferruginous patches. Cromwell's Hill, S. of Kilteely, Co. Limerick.
389. N. 4975.	Fragments of limestone in contact with the trap, No. 388, but showing no marks of alteration. Cromwell's Hill, S. of Kilteely, Co. Limerick.
390. 1035.	Felstone? porphyry: red compact base, with scattered red feldspar crystals and dark patches. Templebredon, four miles N.E. of Hospital, Co. Limerick. Collected by J. O'Kelly.
391. 1083.	Felstone? porphyry: scattered crystals of light coloured feldspar in gray fine grained base. Templebredon, four miles N.W. of Hospital, Limerick. Collected by J. O'Kelly.
392. N. 3069.	Felstone?: pale dull red, earthy looking, with disseminated crystals of pale red feldspar, and a pale green substance in a compact base. Cullen's Hill, Co. Tipperary, S.W. of Limerick Junction. Collected by J. O'Kelly.
393. N. 4948.	Felstone?: compact, dull red, slightly porphyritic. From Maddyboy, ten miles E. of Limerick.
394. N. 4947.	Felstone?: intrusive; pale reddish earthy looking trap, with scattered crystals of feldspar? Maddyboy, between Limerick and Cappamore.
395. N. 4937.	Greenstone?: compact, dull greenish gray. Dyke in Old Red Sandstone. River Bilboa, near Doon, Co. Limerick.
396. N. 4942.	Greenstone?: compact, dull greenish gray. Dyke in Old Red Sandstone. River Bilboa, near Doon, Co. Limerick.

Red Numbers.	Name and Locality, &c.

397. Felstone ? : smaller dyke in the Old Red Sandstone, earthy texture.
N. 4940.
Banks of River Bilboa, near Doon, Co. Limerick.

398. Felstone ? : smaller dyke in Old Red Sandstone, earthy texture.
N. 4989.
Banks of River Bilboa, near Doon, Co. Limerick.

399. Greenstone : amygdaloidal, with nuclei of crystalline calcite. Lower trap band.
B. 1017.
Dromalta, four and a-half miles E. of Caherconlish, Co. Limerick.
Collected by G. H. Kinahan.

400. Felstone ? : porphyritic, grayish red, scattered crystals of feldspar in compact base. Lower trap band.
B. 945.
Boskill, one mile S.S.E. of Caherconlish, Co. Limerick.
Collected by G. H. Kinahan.

401. Felstone ? porphyry : gray feldspar crystals, in dark gray compact base: perfectly columnar in places. Lower trap band.
B. 991.
Knockatancashlane, three-quarters of a mile N. of Caherconlish, Co. Limerick.
Collected by G. H. Kinahan.

402. Felstone : dark purplish gray, very fine micro-crystalline texture, with large crystals of feldspar.
N. 4953.
S. of Knockroe Mason, three miles W.S.W. of Caherconlish, Limerick.

403. Greenstone : porphyritic, greenish feldspar crystals, in dark gray compact base.
N. 4969.
Between Lough Gur and Herbertstown, Co. Limerick. Lower trappean band.

404. Felstone : ? dark grayish purple, with small feldspar crystals in compact base ; forming large, rude, but distinct columns. Lower trappean band.
N. 4956.
Kilteely, Co. Limerick.

405. Felstone ? porphyry : red feldspar crystals, in dark reddish gray compact base. Lower trap band.
B. 969.
Knockaunroe, three miles E. of Kilteely, Co. Limerick.
Collected by J. O'Kelly.

406. Felstone ? porphyry : dark earthy purplish gray base, with scattered crystals of green feldspar ; outlying piece of lower trap band, like that near Herbertstown ; see No.
N. 4966.
Roxborough, three miles S. of Limerick.

407. Greenstone : vesicular trap, amygdaloidal vesicles filled with carbonate of lime.
N. 4691.
Roxborough, three miles S. of Limerick.

408. Greenstone : vesicular trap, amygdaloidal vesicles filled with carbonate of lime.
N. 4960.
Roxborough, three miles S. of Limerick.

Red Numbers. — Name and Locality, &c.

409. Black Greenstone? : Basalt? Melaphyre?
N. 4968. The N.E. quarry at Roxborough, Co. Limerick.

410. Greenstone, black (melaphyre?), porphyritic, dark feldspar
B. 920. crystals, scattered in a nearly black compact base.
Cahernârry-keane, four miles S.E. of Limerick.
Collected by G. H. Kinahan.

411. Basalt? (melaphyre?): dark gray compact base, with small
N. 4952. scattered feldspar crystals. Small detached bed in the carboniferous limestone.
Dromsallagh, near Cappamore, Co. Limerick.

412. Basalt? (melaphyre?): dark gray compact base, with small
N. 4983. scattered feldspar crystals. Small detached bed in the Carboniferous limestone.
Dromsallagh, near Cappamore, Co. Limerick.

413. Basalt?: black greenstone? melaphyre? fine grained, sugary
B. 821. texture, in regular beds.
N. of Melick House, near Carrigogunnell, Co. Limerick.
Collected by G. H. Kinahan.

414. Greenstone?: dark reddish, vesicular earthy trap, becoming
B. 834. amygdaloidal from vesicles being filled up with kernels of carbonate of lime.
W.S.W. of Carrigogunnell Castle.
Collected by G. H. Kinahan.

415. Greenstone: basalt or melaphyre?
Knocksentry, three miles S.E. of Castleconnell, peak of hill, Co. Limerick.

416. Greenstone: basalt or melaphyre?
Knocksentry, three miles S.E. of Castleconnell, peak of hill, Co. Limerick.

417. Basalt?: melaphyre? black greenstone? black, compact; dis-
N. 4959. tinctly and regularly columnar. Upper trap band.
Rathjordan, S. of Ballybrood, on road to Herbertstown, Co. Limerick.

418. Purplish amygdaloidal trap: small close vesicles full of
B. 934. carbonate of lime, dispersed crystals of feldspar. On road 150 yards N. of 429.
Rathjordan, S. of Ballybrood, Co. Limerick. Upper trap band.
Collected by J. O'Kelly.

419. Basalt?: melaphyre,? black greenstone? black, compact,
N. 4960. distinctly and regularly columnar. Upper trap band.
Rathjordan, S. of Ballybrood, on road to Herbertstown, Co. Limerick.

420. Greenstone: dark green base, with scattered crystals of red
N. 4937. feldspar, intrusive? into Coal Measures.
Hill top, S. of Ballybrood, Co. Limerick.

Red Numbers.	Name and Locality, &c.
421. N. 4958.	Greenstone: dark green base, with scattered crystals of red feldspar, intrusive? into Coal Measures. Hill top, S. of Ballybrood, Co. Limerick.
422. N. 4977.	Greenstone?: intensely hard fine grained trap, green with black spots, like some variety of Toadstone. S. of Nicker, near foot of Pallas Hill, Limerick.
423. N. 4979.	Greenstone?: intensely hard fine grained trap, green with black spots, like some variety of Toadstone. S. of Nicker, near foot of Pallas Hill, Co. Limerick.
424. N. 4978.	Greenstone?: intensely hard fine grained trap, green with black spots, like some variety of Toadstone. S. of Nicker, near foot of Pallas Hill, Co. Limerick.
425. N. 4976.	Greenstone?: intensely hard fine grained trap, green with black spots, like some variety of Toadstone. S. of Nicker, near foot of Pallas Hill, Co. Limerick.
426. B. 869.	Trappean ash: fine grained, compact, slightly calcareous. Skool Hill, between Limerick and Bruff. Collected by J. O'Kelly.
427. B. 865.	Gray compact ash, with calcareous concretions. A thin bed in the limestone. Stone Park Quarry, one mile E. of Ballynagarde House, Co. Limerick.
428. B. 812.	Green ash and Carboniferous limestone blended together in same block. Carrigmartin, near Cahernarry, five miles S.S.E. of Limerick.
429. B. 815.	Trappean ash: purple, regularly banded in fine and coarse layers, with crystalline lumps of carbonate of lime, and pieces of altered Carboniferous limestone. Cahernarrykeane, four miles S.E. of Limerick.
430. B. 809.	Trappean ash and Carboniferous limestone, blended in same block. Carrigmartin Quarry, near Cahernarry, five miles S.S.E. of Limerick.
431. B. 996.	Trappean ash: green, very fine grained layers alternating with compact layers. Templemichael, one mile E. of Caherconlish, Limerick. Collected by G. H. Kinahan.
432. B. 883.	Trappean ash, or Breccia of angular fragments of various kinds of trap. Near Lough Gur, Co. Limerick. Collected by J. O'Kelly.
433. B. 826.	Trappean ash: fragments of trap in dull purple earthy base, with scattered crystals of feldspar apparently innate. N. of Carrigogunnell Castle, Co. Limerick. Collected by G. H. Kinahan.

Red Numbers.	Name and Locality, &c.

434. B. 825. Purple ash: regular, alternating, fine and coarse grained layers of trap, fragments and powder; crystals of carbonate of lime, disseminated through the mass.
Half a mile N. of Carrigogunnell Castle, Co. Limerick.
Collected by G. H. Kinahan.

435. B. 1024. Trappean ash: fragments of trap in highly calcareous ashy base.
Carrigogunnell, Co. Limerick.

436. Green ash.
Knocksentry, three miles S.E. of Castleconnell, Co. Limerick.

437. C. 3226. Trappean ash: fragments of green vesicular trap in a base of mixed trap powder and calcareous spar.
Outskirts of the city of Limerick, on N.E. side.

438. N. 4951. Green trappean breccia.
Townland of Portnard, Cappamore, Limerick.

439. N. 4950. Trap breccia.
Townland of Portnard, near Cappamore, Limerick.

440. N. 4982. Trappean ash or Breccia: with large fragments of trap and limestone. Large block on ground tier.
From loose blocks probably not far travelled, Kilpeacon, Co. Limerick.

441. B. 989. Trappean ash: gray, fine alternating with coarse layers. Upper trap band.
Wonder Hill, three miles S.E. of Ballybrood, Co. Limerick.
Collected by J. O'Kelly.

442. C. 706. Green ash.
Kilmoylan, near Shangolden, Co. Limerick.
Collected by G. H. Kinahan.

443. Trappean ash: compact, gray weathering brown which shows it to be calcareous.
Knockavilla, near Dundrum, Co. Tipperary.
Collected by J. O'Kelly.

444. C. 1718. Green trappean ash: in beds in the Old Red Sandstone.
Ballinleeny, eight miles N.W. of Kilmallock, Co. Limerick.
Collected by J. O'Kelly.

[Numbers 445 to 455 reserved for future specimens.]

ELVANS.

456. N. 3198. Elvan: nearly white, crystalline granular mixture of feldspar and quartz, with some plates of white mica.
Near Blackchurch, Rathcoole.

457. N. 1415. Felstone, or elvan ?: pale pink.
Grange, near Canpile, Co. Wexford.

Red Numbers. — Name and Locality, &c.

458. Felstone, or elvan ? : pale pink.
N. 1414. Grange, near Canpile, Co. Wexford.

459. Elvan :
50. From a dyke, near Rathdrum, County Wicklow.

460. Elvan : with black mica.
From a dyke, near Raheenavine House, W. of Avoca, Co. Wicklow.
Collected by Professor Oldham.

461. Elvan : with black mica.
From a dyke, near Raheenavine House, W. of Avoca, Co. Wicklow.
Collected by Professor Oldham.

462. Elvan : nearly true granite ; showing deep weathering.
N. 2995. W. side of Arklow Rock, Co. Wicklow.

463. Elvan : where it cuts into greenstone.
N. 2989. Rock Little, Arklow, Co. Wicklow.

464. Elvan : where it cuts into greenstone.
N. 2988. Rock Little, Arklow, Co. Wicklow.

465. Elvan : nearly true granite ; showing deep weathering.
N. 2994. W. side of Arklow Rock, Co. Wicklow.

466. Elvan : nearly true granite ; showing deep weathering.
N. 2991. W. side of Arklow Rock, Co. Wicklow.

467. Elvan : nearly true granite ; showing deep weathering.
N. 2992. W. side of Arklow Rock, Co. Wicklow.

468. Elvan :
N. 2993. From the top of the quarry in a dyke, near Rock Little, Arklow.

469. Elvan :
202. Cronmore, between Aughrim and Ballynaclash, Co. Wicklow.

470. Elvan : gray, nearly compact.
[illegible]. From a dyke, Garymore, near Rathdrum, Co. Wicklow.

471. Elvan (a true granite).
19. From a dyke on the hill S. of Clonroe cross roads, southward of Croghan Kinshela.
Collected by Dr. Sullivan.

[Numbers 472 to 475 reserved for future specimens.]

GRANITES.

476. Granite : with coarse vein.
W. side of Kippure, Kilbride, Co. Wicklow.
Collected by W. L. Willson.

477. Granite :
From W. side of Kippure, Kilbride, Co. Wicklow.
Collected by W. L. Willson.

Red Numbers.	Name and Locality, &c.
478. J. 898.	Granite : fine grained (? eurite). From a large mass, S. of the tunnell in the cutting of Dublin and Bray Railway, Co. Dublin.
478*a*.	Eurite ? vein in granite. Dalkey Hill, Co. Dublin.
479.	Granite: with schorl on face of joint. Dalkey or Killiney. Collected by G. V. DuNoyer.
480.	Granite : with schorl on face of joint. Dalkey or Killiney. Collected by G. V. DuNoyer.
481.	Granite : with layers of mica plates giving a gneisose structure to the granite. Large block on ground tier. From a large vein at back of Killiney Park. See Explanation of Sheets 102 and 112 of Maps of G. S. I. Collected by G. V. DuNoyer.
482.	Granite : with fine grained vein (eurite ?). Large block on ground tier. Dalkey Hill. Collected by G. V. DuNoyer.
483.	Granite : with plumose mica. From blocks, near Wyatville Farm, Ballybrack, Killiney, Co. Dublin. Collected by G. V. DuNoyer.
484.	Granite : with weathered surface, upper part of a natural crag. Ballybrack, Killiney, Co. Dublin.
485. N. 2899.	Granite : fine grained, in contact with mica schist. Ballybrack, Dalkey, Co. Dublin.
486.	Granite : gray, with a face very little weathered, said to have been exposed for at least twelve years in an old quarry. Large block on ground tier. Ballybrack, Killiney.
487.	Granite : in which the mica has taken a beautiful plumose form. Ballybrack, near Killiney. Collected by G. V. DuNoyer.
488.	Granite : in which the mica has taken a beautiful plumose form. Large block on lower shelf. Ballybrack, near Killiney. Collected by G. V. DuNoyer.
489.	Granite : with weathered surface. From the quarries at Glencullen, S. of Dublin.
490.	Granite : Powerscourt Mountain, Co. Wicklow. Collected by Professor Oldham.

Red Numbers.	Name and Locality, &c.
491.	Granite : From Powerscourt, Co. Wicklow. Collected by Professor Oldham.
492.	Granite : From Powerscourt, Co. Wicklow. Collected by Professor Oldham.
492*a*.	Granite : with vein of quartz and mica. Powerscourt, Co. Wicklow. Collected by Professor Oldham.
493. J. 734, n.	Granite : largely quarried for building stone. From the quarries of Ballynockan, S. of Blessington.
494. N. 743.	Granite : coarse, in contact with mica schist. Near Blessington, Co. Wicklow.
495. J. 741.	Granite and mica schist showing junction. S. of Lugnagun Great, near Blessington, Co. Wicklow.
496. J. 735, n.	Granite : from lowest and hardest part of quarry. Ballynockan, near Blessington, Co. Wicklow.
497. N. 737.	Granite : with coarse vein running along a joint. Ballynockan, near Blessington, Co. Wicklow.
498. N. 2976.	Granite : From Rockabill, off coast of Dublin. Presented by R. Callwell, Esq.
499. N. 2978.	Granite : From Rockabill, off coast of Dublin. Presented by R. Callwell, Esq.
500.	Granite : large block on ground tier. From Rockabill Island, near Skerries, Co. Dublin. Presented by R. Callwell, Esq.
501. 295.	Granite : full of black mica. Glenmalure, Co. Wicklow.
502. 294.	Granite : with both black and white mica. Glenmalure, Co. Wicklow.
503. 296.	Granite : with white mica. Glenmalure, Co. Wicklow.
504. J. 41.	Granite (gneissose) : laminated from arrangement of mica. From Camlin Gap, W. side of Gap of Sculloge, on road from Bagenalstown to Wexford.
505.	Granite : From Hacketstown, Co. Wicklow. Collected by W. L. Willson.
506.	Granite : Castle Dermot, Co. Kildare. Collected by Professor Oldham.
507.	Granite : Castle Dermot, Co. Kildare. Collected by Professor Oldham.

Red Numbers. — Name and Locality, &c.

508. Granite: with spodumene.
From loose block at Mullinacuff, S.W. of Tinaheely, Co. Wicklow.
Collected by Professor Oldham.

509. Granite with large crystals of black mica.
Graignaspidoge, Co. Carlow.
Presented by Rev. Professor Haughton.

510. Granite.
Kilballyhugh, Co. Carlow.
Presented by Rev. Professor Haughton.

511. N. 1132. Granite: greatly decomposed.
E. side of Coolkenna, Co. Carlow.

512. Granite.
Talbotstown, S. of Kilranelagh.
Collected by Professor Oldham.

513. Granite: with a gneissose structure.
From Wicklow Gap.
Collected by Professor Oldham.

514. K. 356. Granite (like that of the Main chain.)
Near Brownsford Bridge, Killene, near Inistioge, Co. Kilkenny.

515. K. 337. Granite: like some of the detached pieces away from the Main chain in Co. Wexford.
From a field under R of parish name of Kilcross, in 6-inch map, Kilkenny, $^{23}/_{1}$ E. of Inistiogue.

516. Granite: with plumose mica.
Derrylossary, above Luggalaw, Co. Wicklow.
Collected by Professor Oldham.

517. Granite.
Poulmounty, Co. Wexford.
Presented by Rev. Professor Haughton.

518. J. 8-9. Granite: easily decomposing.
North-west corner of Mount Blackstairs, Co. Wexford.

519. K. 413. Granite: porphyritic, with large crystals of white feldspar.
From the roadside between Luggalaw and Sally Gap, Co. Wicklow.

520. K. 412. Granite: porphyritic, with large crystals of white feldspar, and a band of largely crystalline feldspar and mica.
From the roadside between Luggalaw and Sally Gap, Co. Wicklow.

521. K. 414. Granite: very fine grained, having a uniform gray tint; looks like good building stone.
Boulder, near Roundwood, Co. Wicklow.

522. J. 20. Elvan passing into granite.
Croaghan Kinshela.

Red Numbers.	Name and Locality, &c.

523. Elvan passing into granite.
N. 2964. Croaghan Kinshela, Co. Wicklow.

524. Elvan passing into granite.
N. 1124. Croaghan Kinshela, Co. Wicklow.

[The above three specimens were taken from different parts of the hill, but show very slight difference among themselves.]

525. Granite : a more nearly true granite than some other parts of the hill.
N. 2963. Croaghan Kinshela, Co. Wicklow.

526. Granite : dull greenish, without mica (elvan granite, or elvanite.)
M. 1126. Croaghan Kinshela, Co. Wicklow.

527. Granite : imperfect.
N. 2962. Croaghan Kinshela, Co. Wicklow.

528. Granite.
N. 1119. From Tinnakilly Upper, near Aughrim, Co. Wicklow.

529. Granite without mica (elvan granite, or elvanite.)
N. 271. Camaross Mountain, between Wexford and New Ross.

530. Granite, without mica (elvan granite, or elvanite.)
Camaross Hill, between Wexford and New Ross.
Presented by Professor Haughton.

531. Granite, without mica (elvan granite, or elvanite.)
N. 272. Camaross Mountain, between Wexford and New Ross.

532. Granite, without mica (elvan granite, or elvanite.)
J. 805. Camaross Mountain, between Wexford and New Ross.

533. Granite: fine grained, gray, with mica-schist, exhibiting the junction of the two rocks.
210. Ballinacorrig, S. of Rathdrum, Co. Wicklow.

534. Granite.
209. From the W. side of Ballinacorrig, near Ballinaclash, S. of Rathdrum, Co. Wicklow.

535. Granite : whitish piece freshly quarried.
298. From Ballinacorrig, S. of Rathdrum.

536. Granite.
304. From the weathered crags over the quarry, showing the extent of discolouration from weathering.
Ballinacorrig, S. of Rathdrum.

537. Granite.
N. 273. From Ballynamuddagh, near Oulart, Co. Wexford.

538. Granite, with black mica, in contact with dark mica-schist.
N. 274. Ballynamuddagh, E.S.E. of Enniscorthy, Co. Wexford.

539. Granite : easily decomposing, with black mica.
J. 808. From Ballymottymore, E. of Enniscorthy, Co. Wexford.

540. Granite : part of a vein two feet wide traversing mica-schist.
J. 807. Ballymottymore, near Enniscorthy, Co. Wexford.

Red Numbers.	Name and Locality, &c.

541. J. 820. Granite ; eight yards from junction with slates.
Ballydonfin, Co. Wexford.

542. J. 823. Granite : part of vein about two feet wide, cutting through altered rocks about thirty yards from boundary of main mass of granite, and running parallel to it.
Ballyneal, near Ballydonfin, Co. Wexford.

543. J. 819. Granite : junction with mica-schist in same block.
Ballydonfin, S.E. of Enniscorthy, Co. Wexford.

544. Granite fused.
From the tile furnaces, Ballymoon, Bagenalstown, Co. Carlow.
Collected by Professor Oldham.

545. Granite fused.
From the tile furnaces, Ballymoon, Bagenalstown, Co. Carlow.
Collected by Professor Oldham.

546. J. 855. Granite : intensely hard, quartzose, devoid of mica.
From a block by roadside, near Carnsore, Co. Wexford.

547. J. 854. Granite : red and white feldspar, large crystals, little mica.
Carnsore, Co. Wexford.

548. N. 404. Granite : with vein of black trap (basalt, black greenstone, or melaphyre.)
Faughart Hill, Co. Louth.
Collected by —— ?

549. N. 407. Granite : with vein of black trap (basalt, black greenstone, or melaphyre.)
Faughart Hill, Co. Louth.
Collected by —— ?

550. Granite : with vein of black trap (basalt, black greenstone, or melaphyre.)
Faughart Hill, Co. Louth.
Collected by —— ?

551. N. 405. Granite : with vein of black trap (basalt, black greenstone, or melaphyre.)
Faughart Hill, County Louth.
Collected by —— ?

552. Granite : porphyritic, large crystals of flesh-coloured feldspar.
From the Mourne Mountains.
Presented by Rev. Professor Haughton.

553. Syenite.
Ffestiniog, N. Wales.
Collected by A. R. C. Selwyn.

554. Granite or Syenite.
Buddonwood Mountain, Sorrel, Leicestershire, or Quorndon House, Barrow, Ashby.
From Geological Survey of Great Britain.

Red Numbers.	Name and Locality, &c.

555. Granite: with black mica.
Cliff-hill, Charnwood Forest, Leicestershire.
From Geological Survey of Great Britain.

556. Schorl: with quartz.
From the granite near Two Bridges, Dartmore.

557. Schorl: with quartz.
From the granite near Two Bridges, Dartmore.

558. Granite vein cutting through slaty sandstone belonging to the Carboniferous period.
Dartmore, Devonshire.

559. Granite:
N. 1174. From near the junction of the rivers Langon and Loire, between Le Puy and St. Etienne, France.

560. Granite.
N. 1176. From near the junction of the rivers Langon and Loire, between Le Puy and St. Etienne, France.

561. Granite.
N. 1161. From near the village of Chambon, Mount Dor, Auvergne.

562. Granite.
37. From Table Mountain, Cape of Good Hope.

563. Granite.
3372. From the Hill called Boukit Timah, Island of Singapore.

564. Granite.
Endeavour River, N.E. coast of Australia.

565. Granite.
N.E. Coast of Australia.

566. Granite.
2729. Cap Island, Torres Straits, Australia.

567. Granite: very fine grained.
277. Cape Upstart, N.E. coast of Australia.

568. Granite, showing face with large crystals of the constituent minerals.

569. Granite, with vein of quartz and plates of green mica.
I. 373.
570. Granite, with vein of quartz and plates of green mica.

571. Granite: coarse, showing distinct crystals of feldspar, mica, and quartz.
Locality and collector unknown.

572. Granite: fine grained, large slab.
Locality and collector unknown.

574. Granite.
K. 856. From Skiddaw Forest, Cumberland.

575. Granite.
K. 857. From Skiddaw Forest, Cumberland.

Red Numbers.	Name and Locality, &c.

576. Granite: porphyritic, with large flesh-coloured crystals of feldspar, and veins of copper pyrites.
Wasdale Crag, near Shap, Westmoreland.

577. K. 869. Granite: porphyritic, with large flesh-coloured crystals of feldspar, and veins of copper pyrites.
Wasdale Crag, near Shap, Westmoreland.

578. K. 871. Granite: porphyritic, with large flesh-coloured crystals of feldspar, and veins of copper pyrites.
Wasdale Crag, near Shap, Westmoreland.

579. K. 872. Granite: porphyritic, with large flesh-coloured crystals of feldspar, and veins of copper pyrites.
Wasdale Crag, near Shap, Westmoreland.

[Numbers 580 to 595 reserved for future specimens.]

METAMORPHIC ROCKS.

596. K. 365. Micaceous gneiss, or gneissose mica schist.
Slyne Head, Co. Galway, from the outermost rock.
Presented by R. Calwell, Esq.

597. K. 367. Grey gritty gneiss.
The outermost rock of Slyne Head, Co. Galway.
Presented by R. Calwell, Esq.

598. K. 364. Grey Micaceous gneiss.
Black Rock, Co. Mayo.
Presented by R. Calwell, Esq.

599. Gneiss: red and gray. Large block.
Eagle Island, Co. Mayo.
Presented by R. Calwell, Esquire.

600. N. 1378. Grey gneiss, (altered Lower Silurian rock).
Near Graiguenamanagh, Co. Carlow.

601. K. 345. Grey gneiss, (altered Lower Silurian rock).
Near Graiguenamanagh.

602. N. 1380. Gray gneiss, (altered Lower Silurian rock).
Near Graiguenamanagh. Co. Carlow.

603. N. 1403. Gneiss: yellowish, fine grained, altered Lower Silurian grit.
Polmounty, near New Ross, Co. Wexford.

604. N. 1405. Gneiss: yellowish, fine grained, altered Lower Silurian grit.
Polmounty, near New Ross, Co. Wexford.

605. K. 288. Gneiss: conglomeritic, with pebbles of quartz.
From the rock by the Tête Noire Hotel, between Martigny and Chamounix.

606. K. 287. Gneiss: conglomeritic, with pebbles of quartz.
From the rock by the Tête Noire Hotel, between Martigny and Chamounix.

Red Numbers. — Name and Locality, &c.

607. Gneiss (granitoid).
K. 290. Near the Hospice of the Grimsel, Switzerland.

608. Gneiss (granitoid).
K. 289. Handeck Waterfall, Hasli valley, Switzerland.

609. Gneiss : dark grey with red spots.
S. coast of Newfoundland.

610. Micaceous grit in contact with granite.
Brazil Wood, near Mount Sorrell, Leicestershire.
Geological Survey of Great Britain.

[Numbers 611 to 619 reserved for future specimens.]

620. Gneiss : partially fused, and assuming a prismatic structure.
From a vitrified Fort at Banagher, near Dungiven, Co. Derry.
Collected by G. V. DuNoyer.

621.
622.
623.
624.
625.
626.
627.
628. Series of Specimens the same as No. 620.

630. Mica schist, with schorl &c., in immediate contact with granite.
From the neighbourhood of Blessington.
Collector not known.

631. Mica schist : full of andalusite.
Tomduff Co. Carlow.
Collected by Professor Oldham.

632. Mica schist : at some distance from the granite, but showing micaceous glaze and crumpling.
298. S.E. of Drumgoff, Glenmalure, County Wicklow.

633. Mica schist : yellowish, with a peculiar aspect, as if it were a felstone ash metamorphosed.
J. 810. S.E. flank of Mount Blackstairs, Co Wexford.

634. Mica schist : altered Lower Silurian slate showing grit layers.
N. 1392. One mile N.E. of Graiguenamanagh, Co. Carlow.

635. Mica schist : pale grey, with lustrous glaze ; altered Lower Silurian slate, but containing two contorted unaltered white siliceous grit bands.
N. 1368. Polmounty, near New Ross, Co. Wexford.

636. Mica schist : lying between the beds of gneiss, Nos. 603 and 604.
N. 1400. Polmounty, near New Ross, County Wexford.

Red Numbers.	Name and Locality, &c.

637. N. 1896. Mica schist: lying between the beds of gneiss, Nos. 603 and 604.
Polmounty, near New Ross, County Wexford.

The following five specimens are a series to exhibit the gradations of change from a mica schist into a dull earthy clay slate on receding from a small mass of granite.

638. 216. Mica schist: imperfectly developed.
From within five yards of small granite boss of Ballinacorrig, S. of Rathdrum, Co. Wicklow.

639. 212. Mica schist: imperfectly developed.
From within five yards of small granite boss of Ballincorrig, S. of Rathdrum, Co. Wicklow.

640. 214. Mica schist: still more imperfectly developed.
About ten yards farther from the granite than 638 and 639.
Ballinacorrig, S. of Rathdrum, Co. Wicklow.

641. Slate, with small dark specs, but no appearance of mica.
About fifty yard from the granite of Ballinacorrig, S. of Rathdrum, Co. Wicklow.

642. 229. Blue earthy clay slate, quite unaltered.
About 150 yards from the granite of Ballinacorrig, S. of Rathdrum, Co. Wicklow.

643. 99. Clay slate, with small granite vein: the clay slate not made into mica schist, but exhibiting some small black specks, as in 641.
Cronemore, near Avoca, Co. Wicklow.

644. N 1389. Mica schist: imperfect, mottled with dark specks.
About 1 mile from the granite, near Inistioge, Co. Kilkenny.

645. K. 838. Mica schist: with andalusite, and brilliant, dead white, friable mica.
From E. side of Glenmacnass, near Seven Churches, Co. Wicklow.

646. K. 835. Mica schist: with thin beds of but slightly altered grit.
E. side of Glenmacnass, Seven Churches, Co. Wicklow.

647. K. 836. Mica schist: with thin beds of but slightly altered grit.
E. side of Glenmacnass, Seven Churches, Co. Wicklow.

648. Chlorite ? schist, imperfectly developed.
Ballynascrew, Tullybirch, Co. Derry.
From Ordnance Survey.

The following eight specimens show different gradations of change from an earthy clay slate to mica schist, like that of Nos. 635 and 636, on approaching main mass of granite.

649. 1402. Clate slate, with micaceous glaze, showing cleavage oblique to the bedding, and the micaceous glaze apparent throughout the mass.
Near Ballywilliam Bridge N. of New Ross.

Red Numbers. | Name and Locality, &c.

650. Grey earthy clay slate, without glaze.
N. 140. Between New Ross and Polmounty, Co. Wexford.

651. Similar slate, but very micaceous, approaching the granite of Polmounty.
N. 1939. Near New Ross, County Wexford.

652. Clay slate, with a distinct micaceous glaze.
N. 1412. Got from point midway between 650 and 651.

653. Grey earthy clay slate, without glaze.
N. 1378. Between New Ross and Polmounty, County Wexford.

654. Grey earthy clay slate, with a very slight micaceous glaze, but exhibiting the corrugation often characteristic of mica schist.
N. 1418. Between New Ross and Polmounty Co. Wexford.

655. Vacant.

656. Blue clay slates, showing appearance of vein quartz and mica irregularly about it.
N. 1394. Between New Ross and Polmounty, Co. Wexford.

657. Mica schist: (altered Lower Silurian), with radiating imperfectly developed crystals of chiastolite? or andalusite?
K. 219. N. end Killiney Strand, Co. Dublin.

658. Mica schist: (altered Lower Silurian) with radiating imperfectly developed crystals of chiastolite? or andalusite.
K. 405. N. end of Killiney Strand, Co. Dublin.

659. Mica schist: (altered Lower Silurian) with radiating imperfectly developed crystals of chiastolite? or andalusite?
K. 362. N. end of Killiney Strand, Co. Dublin.

660. Chlorite schist.
Locality?
Collector?

661. Actinolite schist.
From the Darling range, Swan River, W. Australia.

662. Asbestiform tremolite.
365. From a large district of metamorphic rocks like these in the Toodyoy district.
Swan River, W. Australia.

663. Hornblende? schist.
367. Toodyoy district, Swan River, W. Australia.

664. Hornblende? schist.
368. Toodyoy district, Swan River, W. Australia.

665. Mica schist: containing crystalline mass of andalusite; large block.
Tomduff, County Carlow.
Collected by Professor Oldham.

Red Numbers. | Name and Locality, &c.

666. Mica schist: containing crystalline lumps of andalusite; large block.
N 581.
Slievereagh, between Baltinglass and Lugnaquilla, County Wicklow.
Collected by Professor Oldham.

667. Mica schist, purple.
N. 1796. From near Maume, County Galway.

668. Garnet rock.
From Aghadooey, near Ballintra, Co. Donegal.
Presented by Rev. Professor Haughton.

669. Mica schist: with garnets.
Donegal.
Collected by Ordnance Survey.

670. Tremolite rock: a band in mica schist.
K. 832. W. side of Glenmacnass, Seven Churches, Co. Wicklow.

671. Chistolite slate: taken from the hill side, about 100 yards above the granite in the Caldew beck.
K. 860.
Skiddaw Forest, Cumberland.

672. Chiastolite slate: partly decomposed; taken from some distance over the granite.
K. 863.
Skiddaw Forest, Cumberland.

673. Chiastolite slate: partly decomposed; taken from some distance over the granite.
K 864.
Skiddaw Forest, Cumberland.

[Numbers 674 to 679 reserved for future specimens.]

680. Quartz rock (quartzite) altered Llandovery sandstone.
Bromsgrove Lickey near Birmingham.

681. Quartz rock (quartzite), from the Cambrian rocks.
J. 856. N. Kerloge, near Town of Wexford.

682. Quartz rock (quartzite). spear head, made from naturally cleaved splinters of quartzite, slightly chipped to a point; used by the natives of Port Essington, who procure it from the interior of the country.
3190.
Port Essington, N. Australia.

683. Quartz rock (quartzite), Cambrian rocks, Ballyduff Lower.
11. N. of Ashford, Co. Wicklow.

684. Sandstone not altered into quartzite, but procured from the centre of a mass of pure quartzite in the Cambrian rocks.
J. 836.
Upton, near Taghmon, Co. Wexford.

685. Quartz rock (quartzite), from the Cambrian rocks.
45. Carrignamack, N. of Devil's Glen, Co. Wicklow.

686. Limestone: metamorphosed, greenish, banded, crystalline, and compact.
Curcullion, Donaghmore, Donegal.
From the Ordnance Survey.

Red Numbers.	Name and Locality, &c.

687. Limestone : metamorphosed grey, highly crystalline.
Kerloges, Clonleigh, Donegal.
From the Ordnance Survey.

688. Limestone : metamorphosed white, coarse statuary marble.
Blairstown, Donaghmore, Donegal.
From the Ordnance Survey.

689. Limestone : metamorphosed dark grey, very crystalline,
Dresnagh, Urney, Donegal.
From the Ordnance Survey.

690. Limestone : metamorphosed, very crystalline.
Dresnagh, Urney, Donegal.
From the Ordnance Survey.

691. Limestone : metamorphosed.
Banagher ? Londonderry ?
From the Ordnance Survey.

692. Limestone : metamorphosed, white, statuary marble.
——?——?
Co. Donegal.
From the Ordnance Survey.

693. Limestone : metamorphosed, greenish grey, very crystalline.
Carnsiven, Donaghmore, Co. Donegal.
From the Ordnance Survey.

694. Vacant.

695. Limestone : metamorphosed, highly crystalline.
Urney, Donegal.
From the Ordnance Survey.

696. Limestone : metamorphosed, dark grey, very crystalline.
Priestown, Raphoe, Donegal.
From the Ordnance Survey,

CLEAVED ROCKS.

697. Clay slate : purple, with bands of fine-grained green grit,
1. beds contorted, grits not cleaved, cleavage planes pinched in the folds of the grit.
From the Cambrian formation, small quarries on the hill N. of the lower end of the Devil's Glen, Co. Wicklow.

698. Clay slate : purple and green grit, the cleavage oblique to
2. the bedding ; Cambrian.
Small quarries N. of the lower end of the Devil's Glen, Co Wicklow.

699. Clay slate : purple, with thin crumpled beds of white and
N. 2902. other coloured grit ; Cambrian.
Small quarries N. of the lower end of the Devil's Glen, Co. Wicklow.

Red Numbers. Name and Locality, &c.

700. N. 2900. Clay slate: purple, with thin crumpled beds of white and other coloured grit; Cambrian.
Small quarries N. of the lower end of the Devil's Glen, Co. Wicklow.
Large block on ground tier.

701. N. 2898. Clay slate: thick and coarse green grit slightly affected by cleavage, which cuts it at right angles, as shown by small pieces of purple slate above and below; Cambrian.
Small quarries N. of the lower end of the Devil's Glen. Co. Wicklow.

702. Vacant.

703. N. 2901. Clay slate: purple, with thin crumpled beds of white and other coloured grits, Cambrian.
Small quarries N. of the lower end of the Devil's Glen, Co. Wicklow.

704. N. 679. Clay slate: banded purple and green,
From the Old Red Sandstone, near Macroom, Co. Cork.

705. Clay slate: purplish, grey and green, banded.
From Lower Silurian rocks, near Balbriggan, Co. Dublin.
Presented by the Quarrymaster.

706. Clay slate: purplish, grey and green banded, from Lower Silurian rocks.
Near Balbriggan, Co. Dublin.
Presented by the Quarrymaster.

707. J. 756, B. Clay slate, with ash beds: the ash but little affected by cleavage, but the blue clay slate traversed by fine cleavage oblique to the bedding.
Bishop's Hill, between Blessington and Ballymore Eustace, Co. Kildare.

708. B. 657. Limestone slate: grey Carboniferous limestone, split by cleavage planes cutting across the bedding, as shown by the variously coloured bands at side of specimen.
Co. Limerick.
Collected by J. O'Kelly.

709. Dark gritty slate (formerly called Greywacke), bands of hard coarse rock traversed by slaty cleavage across bedding.
Charnwood Forest, Leicestershire.

710. K. 854. Clay slate: coarse, gritty, green, showing faint "stripe" or lamination.
From near Ambleside, Westmoreland.

METAMORPHIC ROCKS ALTERED BY CONTACT WITH IGNEOUS ROCKS.

Red Numbers.	Name and Locality, &c.
711.	Conglomeritic grit (Cambrian), altered by Igneous rock. Pedlar Torr, Whitwick, Charnwood Forest, Leicestershire. Geological Survey of Great Britain.
712.	Vacant.
713.	Gritstone: Cambrian, altered into a kind of Quartz rock. Green Hill, Charnwood Forest, Leicestershire. Geological Survey of Great Britain.
714.	Gritstone (Cambrian), banded, indurated, Billa Barrow Hill, Charnwood Forest, Leicestershire. Geological Survey of Great Britain.
715.	Conglomerate (Cambrian), altered and indurated. Broad Hill, near Whitwick, Charnwood Forest, Leicestershire. Geological Survey of Great Britain.
716.	Fine-grained argillaceous sandstone (Cambrian?), altered into a whet slate. Tin Meddow, near Whitwick, Charnwood Forest, Leicestershire. Geological Survey of Great Britain.
717.	Grit: conglomeritic (Cambrian?); altered by igneous rocks. Pedlar Torr, Whitwick, Charnwood Forest. From Geological Survey of Great Britain.
718. N. 841.	Limestone: greenish, very crystalline, altered by trap dyke. From Dundalk. Collected by —— ?
719. N. 924.	Sandstone: of the Carboniferous formation, altered into a quartz rock by contact with greenstone dykes, (see 239). Salisbury Crag, Edinburgh.
720. N. 3234.	Coal: altered into a kind of coke, by contact with dykes of "white rock" trap, proceeding from intrusive masses and sheets of greenstone. Grace Mary Colliery, near Oldbury, S. Staffordshire.
721. N. 3228.	Coal: altered and "blacked," that is dulled, by contact of white rock trap (of which a piece is attached); the altered coal not more than $2\frac{1}{2}$ inches wide, and passing into bright unaltered coal, of which a piece is attached. Grace Mary Colliery, near Oldbury, S. Staffordshire.
722.	Coal: altered by trap, having a "grizzly" aspect, and full of strings and small concretions of carbonate of lime and of quartz; hard and cindery in parts. From a pit bank near Dudley.

Red Numbers.	Name and Locality, &c.

723. Coal: altered by trap like 722, but with glittering black patches.
From near Dudley.

724. N. 3231. "White rock" trap, greenstone altered by penetrating coal in thin dykes and veins.
Grace Mary Colliery near Oldbury, S. Staffordshire.

725. Coal: altered by trap, having a "grizzly" aspect, and full of strings and small concretions of carbonate of lime and of quartz, hard and cindery in parts.
From a pit bank near Dudley.

725A. K. 461. Coal: greatly altered by contact with greenstone.
Hall Farm, Neachells, Wolverhampton.

726. N. 3257. "White rock" trap, greenstone altered by coal.
Grace Mary Colliery, near Oldbury, S. Staffordshire.

727. N. 3230. "White rock" trap, greenstone altered by penetrating coal in thin dykes and veins.
Grace Mary Colliery, near Oldbury, S. Staffordshire.

728. "White rock" trap, penetrating coal, both rocks having undergone a mutual alteration.
Grace Mary Colliery, near Oldbury, S. Staffordshire.

729. 54. Clay slate: altered by contact with Elvan dyke.
Stump of Castle, Co. Wicklow.

730. K. 213. Burnt clay slate (altered Devonian).
Near Pulver Maar, scattered over the side of the little volcanic cone, which lies to the S. of the Pulver Maar (Lower Eifel).

731. Lias: altered by contact of great Cockfield Fell Dyke.
Near Rosebury Topping, Yorkshire.

732. Vacant.

733. K. 415. Lias: with ammonites, altered into a flinty slate rock or hornstone, by contact with a large mass of crystalline greenstone; see N. 223, b.
Portrush, Co. Antrim.

734. Lias with fossil shell, altered into a flinty slate rock or hornstone by contact with a large mass of crystalline greenstone; see N. 223, b.
Portrush, Co. Antrim.

735. K. 149. Chalk of Co. Antrim, slightly indurated beyond its usual texture on approaching a trap dyke.
Cave Hill, near Belfast.

736. K. 460. Chalk of Co. Antrim, converted into a grey splintery compact limestone, close to a trap dyke
Cave Hill, near Belfast.

Red Numbers.	Name and Locality, &c.

737. Chalk flint, reddened and altered by contact of basalt, but now coated by earthy white band, probably the result of subsequent decomposition.
K. 457. From beneath the basaltic capping, Cave Hill, near Belfast.

738. Greensand, altered into a hard siliceous grit of a red colour, with greenish specks and streaks, close to a trap dyke.
K. 454. Cave Hill, near Belfast (see also No. 773)

739. Greensand, (locally called Mulatto stone) of a very dark green colour, enveloping a shell (Exogyra); the sand is often quite incoherent.
K. 450. A few yards from the basaltic dyke, Cave Hill, near Belfast.

740. Chalk flint, from immediately under the basalt which overlies the chalk.
K. 421. From road side three miles E. of Portrush, Co. Antrim.

741. Chalk flint, immediately under basalt.
K. 422. From road side three miles E. of Portrush, Co. Antrim.

742. Chalk flint.
K. 423. Same spot as above, but about three yards below the basalt.

743. Bed of clay, between Basalt and Chalk of Co. Antrim, sometimes 2 feet thick and full of angular flints apparently the old sea bottom on surface of Chalk before the basalt was poured out on it.
K. 445. From shore N. of Ballycastle Harbour, Co. Antrim.

744. Fragments of a furnace hearth from an iron furnace in S. Staffordshire? originally a softish sandstone out of the Coal measures, but altered into a kind of quartz rock by heat of furnace.

AQUEOUS ROCKS, MECHANICALLY FORMED.

SANDY, OR ARENACEOUS ROCKS.

744. *a*. Coarse sandstone, or fine conglomerate.
J. 833. From the Old Red Sandstone, Duncormick, Co. Wexford.

745. Pebble of red jasper, from the conglomerate of the Old Red Sandstone.
Dingle peninsula, County Kerry.
Collected by G. V. DuNoyer.

746. Coarse conglomerate: with quartz pebbles.
Jn. 899. From the Old Red Sandstone.
Near the Town of Wexford.

747. Conglomerate, with quartz pebbles.
Jn. 857. From the Old Red Sandstone of Kerloge near the Town of Wexford.

Red Numbers.	Name and Locality, &c.

748. Conglomerate, with joint surface splitting the quartz pebbles.
From the Old Red Sandstone of Duncormick, Co. Wexford.

749. Pebble of the "Inch" conglomerate, containing pebbles of granite, mica schist, gritstone, &c.
J. 834.
From the Old Red Sandstone near "Inch," Dingle, County Kerry.
Collected by G. V. DuNoyer.

750. Pebble of the "Inch" conglomerate, containing pebbles of granite, mica schist, gritstone, &c.
From the Old Red Sandstone near "Inch," Dingle, County Kerry.
Collected by G. V. DuNoyer.

751. Pebble of the "Inch" conglomerate, containing pebbles of granite, mica schist, gritstone, &c.
From the Old Red Sandstone near "Inch," Dingle, County Kerry.
Collected by G. V. DuNoyer.

752. Conglomerate, with quartz and other pebbles.
From the Culm measures, Devonshire.

753. Feldspathic conglomerate, from Cambrian rocks.
Porth Lisky, S. David's, Pembrokeshire.

754. Conglomerate: recently formed.
N. 3783.
From an Esker ridge in the Co. Tipperary.
Collected by A. B. Wynne.

755. Conglomerate, with large pebbles.
From the Dingle beds, E. side of Ventry Harbour, Dingle, Co. Kerry.
Collected by J. Flanagan.

756. Recent conglomerate: gravel cemented by lime.
Co. Kildare.
Collected by —— ?

757. Conglomerate, from Cambrian ? rocks.
One-half mile N. of Markfield, Charnwood Forest.
From Geological Survey of Great Britain.

758. Conglomerate, from the Dingle Beds.
Summit of Brandon Mountain, Dingle, County Kerry.
Collected by J. Flanagan.

759. Conglomerate, from the Dingle Beds.
Summit of Brandon Mountain, Dingle, Co. Kerry.
Collected by J. Flanagan.

760. Conglomerate: recent, a gravel beach cemented by arragonite.
From the shore, near the baths, Salthill, Kingstown.

760*a*. Conglomerate: recent, some beds of limestone gravel cemented by arragonite.
Glenismole, two miles S. of Tallaght, Co. Dublin.

Red Numbers.	Name and Locality, &c.
761. J. 825.	Gritstone: crystalline grit, resembles an igneous rock at first sight. From the Cambrian rocks, Newtown House, R. Slaney, between Enniscorthy and Wexford.
762. J. 830.	Fine-grained sandstone, with lamination, from the Old Red Sandstone. A little N. of the Town of Wexford.
763. K. 398.	Laminated sandstone: From Annagh Bridge, Coleraine, Queen's Co. Collected by J. O'Kelly.
764.	Sandstone, with curved concentric lines of colour. From the Llandovery Sandstone, Great Barr, S. Staffordshire.
765.	Sandstone, with curved concentric lines of colour. From the Llandovery sandstone, Great Barr, S. Staffordshire.
766.	Gritstone, grey coarse grained like the grit called Glengarriff grit. E. side of Ventry Harbour, Dingle, Co. Kerry. Collected by J. Flanagan.
767. N. 983.	Sandstone, red, fine grained, laminated. From New Red Sandstone between Belfast and Lisburn. Collected by A. Wyley.
768.	Sandstone, with curved concentric lines. From the Llandovery sandstone, Great Barr, S. Staffordshire.
769.	Sandstone: yellow, fine grained, laminated. Great Barr, S. Staffordshire.
770. N. 2960.	Gritstone, Millstone grit, coarse grained, quartzose. From Saddleworth, Yorkshire.
771. C. 1766.	Sandstone, brown, micaceous, flaggy, with concentric colour marks. From the Yellow Sandstone of Ballyan, Co. Limerick. Collected by G. H. Kinahan.
772. N. 1001.	Sandstone: brown, very finely laminated. Coal measures near Manchester.
773. N. 984.	Sandstone: yellowish spotted with green, with fossil shells. From the Greensand of Collin Glen near Belfast (see No. 738.) Collected by A. Wyley.
774. A. 3200.	Sandstone: grey quartzose, with brown ferruginous specks. From the Yellow Sandstone, Co. Limerick, shore of Shannon, between Reenkirk and Mellon points. Collected by G. H. Kinahan.
775.	Sandstone: fine grained. From the Silurian rocks of Castell Caer Sion, near Conway. From Geological Survey of Great Britain.

Red Numbers. Name and Locality, &c.

776. Sandstone: flexible sandstone, Itacolumite; reddish brown, laminated, not very coarse grained, chiefly made up of rounded grains of quartz, slightly micaceous, slab twenty-eight inches long, three and one-half inches broad, and one inch thick, bends easily backwards and forwards, feeling in the hands like a piece of flat cable.
From Brazil.
Purchased by Sir R. Kane.

777. Sandstone: dark red thin flag, a dark micaceous surface, pitted over with slight eminences, believed to be casts of the "pits" made by rain that had fallen on the surface beneath, previously to the deposition of this layer.
From the neighbourhood of Annan, Dumfries.
Presented by Professor Harkness.

778. Sandstone: dark red, flaggy, with a curious concretionary surface, which was probably the under surface of the flag, exhibiting casts of a crack and of a "dimple current marked" surface that had been formed on the bed below.
From Carse Hill, near Annan, Dumfries.
Presented by Professor Harkness.

779. Sandstone, or flagstone: grey, micaceous, exhibiting "a current mark" or "ripple" three inches broad on one side, and the cast of a similar ripple equally broad on the other side, with the cast of a track also on that side. The two current marks coincide in direction.
From the Coal Measures of Kilkee, Co. Clare.
Collected by —— ?

780. Sandstone: dark red, flaggy, with the cast of a large "dimple current" mark on one side, and on the other a smooth micaceous surface, pitted with small hollows, believed to have been caused by a shower of rain falling while the sand was yet soft, and probably while it was exposed at low tide on the beach.
From near Annan, Dumfries.
Presented by Professor Harkness.

781. Sandstone: dark red, flaggy, with a very regular "current mark" or "ripple" on one side, about one-inch broad, and the cast of a similar one in same direction on other side.
From near Annan, Dumfries.
Presented by Professor Harkness.

782. A. 1972. Sandstone, or flagstone: dark grey, very fine grained, exhibiting a "ripple" or "current mark," three inches broad on one side, and the cast of a similar one on the other side.
Coolclough, near Kanturk, Co. Cork.
Collected by —— ?

Red Numbers. Name and Locality, &c.

783. Sandstone, a thick flagstone: grey, fine grained, exhibiting a "ripple" or "current mark," three inches broad, on one side, and the cast of another, only one-inch broad and rather different in direction, on the other side.
From —— ?
Collected by —— ?

784. N. 959. Sandstone, or gritstone: fine grained, grey, thin bedded laminated, bent into a curve as sharp as that of a horse-shoe.
Wicklow, near Ballinagappoge Bridge, S. of Croaghan Moira.
Collected by A. Wyley.

785. N. 960. Sandstone, or gritstone: greenish grey, fine grained, hard and tough, bent into several sharp undulations.
Near Ballynagappoge Bridge, S. of Croaghan Moira.
Collected by A. Wyley.

786. J. 128. Sandstone, or gritstone: grey, fine grained, very hard.
From the Coomhola grits, in the Carboniferous slate, half-a-mile N. of Ballylickey Bridge, Bantry, Co. Cork.
Part of a bed, two inches thick, from the summit of a small anticlinal. The specimen forms a sharp curve one foot wide and six inches high.

787. Vacant.

788. N. 1005. Sandstone: brownish, concretionary, calcareous, with fossil shells.
From the Carboniferous slate, Moviddy, Valley of Bride, Co. Cork.

789. Vacant.

[The following specimens, from 790 to 805 inclusive, are part of the duplicates of a series collected during the voyage of H.M.S. *Fly*. They are introduced here in case any one should wish to refer to them as examples of the widely spread superficial ferruginous deposits in Australia and the adjacent parts of the world.]

790. 317. Sandstone: highly ferruginous, nearly an iron sand.
Port Essington, N. Australia.

791. 378. Iron ore.
From some E. and W. veins near Guildford, Swan River, W. Australia.

792. 318. Sandstone, highly ferruginous.
Port Essington, N. Australia.

793. 381. Ferruginous concretions, from sandstone.
Port Essington, N. Australia.

794. 3684. Sandstone, highly ferruginous.
From Brighton, Port Philip, Victoria, S.E. Australia.

795. 3704. Sandstone, highly ferruginous.
From Brighton, Port Philip, Victoria, S.E. Australia.

Red Numbers. | Name and Locality, &c.

796. Ferruginous coating, general over the hills of the Darling range.
355. Swan River, W. Australia.

797. Iron ore.
372. From some E. and W. veins near Guildford, Swan River, W. Australia.

798. Sandstone, highly ferruginous.
3707. From Brighton, Port Philip, Victoria, S.E. Australia.

799. Ferruginous coating, general over the hills of the Darling range.
356. Swan River, W. Australia.

800. Ferruginous masses, iron ore in sandstone.
3377. Near the town of Singapore.

801. Ferruginous masses, iron ore in sandstone.
3379. Near the town of Singapore.

802. Ferruginous masses, iron ore in sandstone.
3376. Near the town of Singapore.

803. Sandstone: dull reddish yellow, fine grained, quartzose.
3374. From near the town of Singapore.

804. Ferruginous sand rock.
3371. Malacca.

805. Sandstone: highly ferruginous, nearly an iron sand.
319. Port Essington, N. Australia.

806. Sandstone: variously mottled, fine grained.
From the Eocene beds of Alum Bay, Isle of Wight.
Purchased from a dealer.

807. Sandstone: variously mottled, fine grained.
From the Eocene beds of Alum Bay, Isle of Wight.
Purchased from a dealer.

808. Sandstone: variously mottled, fine grained.
From the Eocene beds of Alum Bay, Isle of Wight.
Purchased from a dealer.

809. Sandstone: variously mottled, fine grained.
From the Eocene beds of Alum Bay, Isle of Wight.
Purchased from a dealer.

810. Sandstone: pale grey, very fine grained, siliceous, with univalve and bivalve shells.
N. 1236. A tertiary sandstone, used for mending the roads near Paris.

811. Sandstone, or gritstone: nearly white, very fined grained, purely siliceous sand, part of the Sable de Fontainebleau, concreted partly by lime, from the overlying Calcaire de la Beauce.
N. 1236. From quarries half-a-mile S. of Etampes, thirty miles S. of Paris.

Red Numbers. | Name and Locality, &c.

812. Sandstone, or gritstone (called Gres lustreé): very fine
N. 1237. grained, and purely siliceous, part of the Sable de Fontainbleau, compacted by a siliceous infiltration.
From quarries half-a-mile S. of Etampes, thirty miles S. of Paris.

813. Burrstone or Mouilliere.
N. 1241. From a loose block in the neighbourhood of Paris.
Out of some of the Tertiary beds near Paris.

814. Polishing stone.
K. 404. From a stream two miles E. of Kinnity, King's Co.
Collected by J. O'Kelly.

815. Concretion of very fine silty sand.
K. 402. In the Delour River, at Bennett's Bridge, four miles N.W. of Mountrath, Queen's Co.
Collected by J. O'Kelly.

816. Concretion of very fine silty sand.
K. 399. In the Delour River, at Bennett's Bridge, four miles N.W. of Mountrath, Queen's Co.
Collected by J. O'Kelly.

817. Concretion of very fine silty sand.
K. 403. In the Delour River, at Bennett's Bridge, four miles N.W. of Mountrath, Queen's Co.
Collected by J. O'Kelly.

818. Concretion of very fine silty sand.
K. 401. In the Delour River, at Bennett's Bridge, four miles N.W. of Mountrath, Queen's Co.
Collected by J. O'Kelly.

819. Concretion of very fine silty sand.
In the Delour River, at Bennett's Bridge, four miles N.W. of Mountrath, Queen's Co.
Large slab on ground tier.
Collected by J. O'Kelly.

CLAYEY OR ARGILLACEOUS ROCKS.

820. Clay Slate Rock: dark gray argillaceous rock, indurated,
N. 1010. with transverse cleavage.
Neighbourhood of Waterford.

821. Clay Slate, or indurated shale, with impressions of plants.
From the Culm Measures, one mile S. of Launceston, Co. Cornwall.

822. Indurated Shale, or argillaceous flagstone, showing both lamination and jointing.
From near Ferriter's Cove, Dingle.
Collected by J. W. Salter.

823. Fire Clay: black, unctuous to the touch.
From the Coal Measures, near Wigan, Lancashire.

Red Numbers. | Name and Locality, &c.

824. Fire Clay, with "slickensides," or polished surface, from a fault which brought down this fire clay against a bed of coal ; the whole substance of the fire clay splitting into small fragments, coated with these slickenside surfaces.
Colliery, near Wigan, Lancashire.

825. N. 1269. Fire Clay, with "slickensides," or polished surface, from a fault which brought down this fire clay against a bed of coal ; the whole substance of the fire clay splitting into small fragments, coated with those slickenside surfaces.
Colliery, near Wigan, Lancashire.

826. N. 3292. Indurated Sandy Shale, with slightly oblique lamination.
From Knockinglass Colliery, Co. Tipperary.
Collected by J. O'Kelly.

827. N. 2866. Indurated Shale, exibiting rough striated slickenside surface.
Co. Dublin.
Collected by G. V. DuNoyer.

828. Vacant.

829. K. 407. Shale, with slickenside surface.
Lickeen West, Co. Clare.
Collected by F. J. Foot.

830. J. 137. Clay Slate : black earthy. Of the size called the First Lady.
From the Carboniferous Slate, near Dromaleague, Co. Cork.

831. Vacant.

832. Clay, with greensand, containing fossil shells.
From the Barton Clay, on the shore of Dorsetshire.

833. N. 929. Marl, now dry and hard.
From the Pleistocene Beds of Courtown, Co. Wexford
Collected by —— ?

834. Clay, with fossil shells, now dry and indurated.
From the Barton Clay, on coast of Dorsetshire.

835. F. 816. Clay : concretionary, nodular, pale reddish yellow.
Carrigmartin Quarry, County Limerick, $^{18}/_{4}$.

836. Pipe Clay, with lignite.
From pits near Caher, Co. Tipperary.
Collected by A. B. Wynne.

837. Clay : white pipe clay.
From Brackleshan Beds, Alum Bay, Isle of Wight.
Geological Survey of Great Britain.

838. N. 1257. Clay, or marl, passing into a freshwater limestone.
From the Tertiary Beds, at Chaumont, Montmartre, Paris.

839. C. 1638. Clay Ball : concretionary nodular, impure clay ironstone.
From the Coal Measure Shales, N. of Loghill, Co. Limerick
Collected by G. H. Kinahan.

Red Numbers. | Name and Locality, &c.

840. Clay Ball: concretionary nodular, impure clay ironstone.
C. 1639. From the Coal Measure Shales.

841. Clay Ball: concretionary nodule, slightly waterworn.
Locality —— ?
Collected by —— ?

842. Clay: ferruginous (? bole), looks like decomposed igneous rock.
From —— ?
Collected by —— ?

843. Cone in cone: clay ironstone, impure, with a concretionary structure, common in some clay ironstones or clays containing iron, the result of concretionary action set up in the rock after deposition. Mode of action not yet determined.
S. Staffordshire.

844. Cone in cone (see 843).
K. 230. Near Chesterfield, Derbyshire.

845. Cone in cone (see 843).
K. 406. From the Coal Measures at the Cliffs of Moher, Co. Clare.
Collected by F. J. Foot.

846. Cone in cone (see 843).
From the Coal Measures at the Cliffs of Moher, Co. Clare.
Collected by F. J. Foot.

847. Shale, with small round flat concretions.
From the Coal Measures at Agher, Summerhill, Co. Meath.
Collected by G. V. DuNoyer.

848. Shale, with small round flat concretions.
From the Coal Measures at Agher, Summerhill, Co. Meath.
Collected by G. V. DuNoyer.

849. Shale, with small round flat concretions.
From the Coal Measures at Agher, Summerhill, Co. Meath.
Collected by G. V. DuNoyer.

850. Shale, with small round flat concretions.
From the Coal Measures at Agher, Summerhill, Co. Meath.
Collected by G. V. DuNoyer.

851. Shale, with round nodular concretions, from the Carboniferous slate.
N. 634. W. side of Old Head of Kinsale, Co. Cork.
Collected by G. V. DuNoyer.

852. Black shale: nodule, with centre of carbonate of iron crystallized.
From —— ?
Collected by —— ?

853. Flat round nodule of impure clay ironstone.
113. From —— ?
Collected by —— ?

Red Numbers.	Name and Locality, &c.

854. N. 639. Shale, with round nodular concretions, from Carboniferous slate.
W. side of Old Head of Kinsale, Co. Cork.
Collected by G. V. DuNoyer.

855. Septarian nodule, showing central cracks.
From ——?
Collected by ——?

856. Half of a long spindle-shaped nodule of shale, or clay, indurated by iron, a band of fossil shells running through the centre of it.
Coal Measures near Kilrush, Co. Clare.

857. Nodular red hæmatite to illustrate nature of concretions.
From ——?
Collected by ——?

858. Bole.
Down Hill, Co. Derry.
Ordnance Survey.

859. Indurated sandy shale, with slightly oblique lamination.
From Knockinglass Colliery, Co. Tipperary.
Collected by J. O'Kelly.

860. Indurated sandy shale, with slightly oblique lamination.
From Knockinglass Colliery, Co. Tipperary.
Collected by J. O'Kelly.

861. N. 1366. Black clay slate: with spherical concretionary nodules at intervals. Carboniferous slate.
Between Bandon and Kilbrittain, Co. Cork.

862. Vacant.

863. Clay ball: concretionary nodular, impure clay ironstone.
From the Coal Measure shales, N. of Loghill, Co. Limerick.
Collected by G. H. Kinahan.

864. Slickenside surfaces in argillaceous rocks.
From the Upper Silurian, near Ferriter's Cove, Dingle, Co. Kerry.
Collected by J. W. Salter.

865. N. 4919. Shale: dark earthy, compact, hard, calcareous, jointed into regular rhombs.
From a thin bed in a black flag quarry, N. of Edenderry.
Collected by G. V. DuNoyer.

CHEMICALLY, AND CHEMICO-ORGANICALLY FORMED AQUEOUS ROCKS.

LIMESTONES OR CALCAREOUS ROCKS.

Red Numbers. — Name and Locality, &c.

866. Travertine: an egg coated over with minutely and beautifully crystalline layer of travertine.
From the travertine works at Clermont, Auvergne.

867. Travertine: a plaster cast of fruit, coated over with minutely and beautifully crystalline layer of travertine.
From the travertine works at Clermont, Auvergne.

868. Stalactite: showing central pipe and concentric rings of deposition, with crystalline fibrous structure radiating from centre
From ——?
Collected by ——?

869. K. 358. Stalactite: small oblique pendant, with concentric coats proceeding from one side, the original formation having apparently commenced on a projecting rib of rock.
From the Mitchelstown Caves.

[This and the following twelve specimens were purchased from Mrs. Slarke, of the Hotel, Mitchelstown].

870. K. 356. Stalactite: part of a sheet with external rippling, caused by trickling of water from which carbonate of lime was deposited. This specimen is as largely and beautifully crystalline internally as any metamorphic limestone.
From the Mitchelstown Caves.

871. K. 353. Stalagmite: probably formed on slightly sloping surface showing impression of that surface beneath, and the concentric coats traceable through a completely crystalline structure.
From the Mitchelstown Caves.

872. K. 351. Stalagmite?: showing some layers of deposition enclosing cavities full of plumose branches of minutely crystalline carbonate of lime, of a yellow colour.
From the Mitchelstown Caves.
Its exact mode of occurrence not known.

873. K. 354. Stalagmite: probably formed on slightly sloping surface, showing impression of that surface beneath, and the concentric coats traceable through a completely crystalline structure.
From the Mitchelstown Caves.

Red Numbers. | Name and Locality, &c.

874. Stalactite: apparently formed on the side of a small ridge,
K. 357. showing small overhanging projecting lips one above another, like the eaves of a ridge tiled roof; underneath each of which is a mass of minute crystals of carbonate of lime in small bunches. The whole crystalline internally.
From the Mitchelstown Caves.

875. Stalactite: pendant, two feet long, flattish at top, becoming
K. 359. round and tapering to a point showing original tube of commencement on one side of flat part, with successive coats of deposition round on one side of it, all traversed by the crystals of the subsequently acquired crystalline structure.
From the Mitchelstown Caves.

876. Stalactite: a flat piece like the upper part of No. 875, but
K. 355. paler, nearly translucent.
From the Mitchelstown Caves.

877. Stalagmite: a mammillated surface of concretionary car-
K. 349. bonate of lime, with small spheroidal knobs above, flat surface below.
From the Mitchelstown Caves.

878. Stalagmite: a mammillated surface of concretionary car-
K. 350. bonate of lime, with small spheroidal knobs above, flat surface below.
From the Mitchelstown Caves.

879. Stalagmite (or Stalactite): nodular concretionary, showing
K. 352. the commencement of a pillar growing upwards (or a pendant growing downwards).
From the Mitchelstown Caves.

880. Stalagmite (or Stalactite): white earthy, but showing layers
K. 348. of deposition.
From the Mitchelstown Caves.

881. Stalactite: large pendant, nearly perfect, flat at top, eight
K. 360. inches broad, and half inch thick, having along one side of it the impression of the surface of the rock on which it was formed; gradually becoming round below with a circumference of nine and a-half inches, from which it gradually tapers to a point.
Total length three feet six inches.
From the Mitchelstown Caves.

882. Travertine: carbonate of lime coating a bundle of sticks or rushes, which have decayed away and left the hollow cases, which resemble stalactites in their concentric coats and radiating crystallization.
Believed to come from Co. Kildare.
Collected by —— ?

Red Numbers. Name and Locality, &c.

883. Travertine, like 882.
From a little S. of Balbriggan, Co. Dublin.
Collected by G. V. DuNoyer.

884. Travertine, coating rushes, &c.
From the Allebotino, near Colle di Valdelsa, forty miles from Sienna.
Purchased from Signor Ceri.

885. Shell marl: earthy, porous, carbonate of lime, minutely concretionary, containing unaltered shells of planorbis, &c.
From a few miles N.W. of Cahir, Co. Tipperary.

886. The same as 885, but with impressions of plants.
From a few miles N.W. of Cahir, Co. Tipperary.

887. Coral (porites): a massive coral with minute pores and small cells, making apparently the main bulk of the coral reefs of N.E. Australia.
From "The Black Rocks," at the edge of the Great Barrier reef near Wreck Bay, N.E. Coast of Australia.

888. 311. 889. Coral rock: made up of rounded grains of coral and shells (forminifera), with a distinctly oolitic structure commencing in some parts.
From a thin bed between two beds of soil, and therefore composed of grains originally blown by the wind over the lower soil, and subsequently compacted by action of rain water.
From Raines Islet, N.E. Australia.

890. Vacant.

891. Stones and shells, compacted by carbonate of lime.
From the beach near Kingstown.
Collected by Dr. Sullivan.

892. N. 1220. Concretionary travertinous carbonate of lime, like part of 872.
From the tertiary beds of Mount Gergovia, S. of Clermont, Auvergne.

893. N. 1218. Indusial limestone: a congeries of the indusiæ (or cases) of caddis worms, surrounded by minute freshwater shells, compacted into a solid rock.
From beds in the tertiary rocks of Mount Gergovia, S. of Clermont, Auvergne.

894. N. 1339. Freshwater limestone, full of lymnea, &c.
From the "Docks Napoleon," near the termination of the Rouen Railway, Paris.

895. N. 1249. Freshwater limestone.
From a little outside the Barriere de l'Etoile, Paris.

896. N. 1248. Calcaire glauconeux: limestone made of little rounded grains of shells and coral, like No. 888. Forms the base of the calcaire grossier of the tertiary basin of Paris.
From a little N. of Meulan, which is about thirty miles W. of Paris.

Red Numbers. Name and Locality, &c.

897. N. 1247. Calcaire grossier of the Paris basin, consisting of a mass of shells compacted together. The coarse variety of the stone.
From a little N. of Meulan.

898. N. 1246. Calcaire grossier of the Paris basin, consisting of a mass of calcareous grains. The finest variety of the stone.
From a little N. of Meulan.

899. N. 1235. A concretionary botryoidal mass, consisting of the very fine quartzose sand of the Sable de Fontainbleau, compacted by carbonate of lime.
From the quarries S. of Etampes, thirty miles S. of Paris.

900. N. 1206. Freshwater limestone, minutely concretionary.
S. of Le Puy en Valay.

901. N. 1209. Freshwater limestone, compact, with lymnea, &c.
From Espailly, N. of Le Puy en Valay.

902. N. 1204. Freshwater limestone: full of shells of small Planorbis, stone so porous as to float in water like pumice.
From the "Docks Napoleon," terminus of the Rouen Railway, Paris.

[Numbers 903 to 907 reserved for future specimens].

908. Crystalline limestone: grey, completely crystalline.
From the Carboniferous limestone, Ardbrackan quarry, Navan.
Collected by G. V. DuNoyer.

909. B. 951. Limestone: compact, black, with encrinite stems, and a band or vein of compact pale limestone, with strings of copper? and iron pyrites.
Oola Hill, Co. Limerick.
Collected by J. O'Kelly.

910. Black limestone: compact, earthy, with white crystalline patches and slickenside surfaces.
From the Culm Measures, Lufton Head, Launceston, Cornwall.

911. N. 1089. Shell limestone: pale grey, full of shells (Avicula lunulata).
From the Carboniferous limestone, Mallow, Co. Cork.
Collected by G. V. DuNoyer.

912. Shell limestone: full of small oysters, from the marine part of the Purbeck beds, Durlestone Bay, Dorsetshire.
Geological Survey of Great Britain.

913. C. 1650. Limestone with corals (Lithodendron affine).
From the Carboniferous limestone W. side of Creggan Castle, Limerick.
Collected by C. Galvan.

914. C. 3491. Limestone with corals (Lithodendron affine).
From the Carboniferous limestone from Dromore, Limerick.
Collected by C. Galvan.

Red Numbers. | Name and Locality, &c.

915. Limestone with corals (Lithodendron affine).
C. 3487. From the Carboniferous limestone.
Collected by C. Galvan.

916. Limestone full of shells, or concretions resembling shells.
From near Clonmel.
Collected by G. V. DuNoyer.

917. Limestone: argillaceous, slaty, contains fossil shells. Calcareous band.
J. 129. From the Carboniferous slate, Reenydonegan point, Bantry Bay.

918. Limestone: argillaceous, flaggy, full of fossils. (Wenlock Limestone).
From Dudley, S. Staffordshire coal field.

919. Limestone: a bed four or five inches thick (with cone in cone on upper surface), full of shells.
N. 3391. From the Coal Measures of Kilkee, Co. Clare.
Collected by F. J. Foot.

920. Limestone, with concretionary markings on upper surface, called caudagalli (cockscomb).
From the Carboniferous rocks (Lower Coal Measures or Mountain limestone), Dunbar, upper bed.
Geological Survey of Great Britain.

[Numbers 921 to 923 reserved for future specimens].

924. Oolitic limestone, with shells.
From the Bath oolite, Minchinhampton, Gloucestershire.

925. Oolitic (or pisolitic) limestone: coarse, with shells. Called the "Pea grit."
K. 1455. Leckhampton, near Cheltenham.

926. Limestone: flaggy, called "Stonesfield slate."
N. 1451. E. of Bridlip, near Cheltenham.

927. Limestone: flaggy, called "Stonesfield slate."
N. 1453. E. of Bridlip, near Cheltenham.

928. Limestone: flaggy, called "Stonesfield slate."
N. 1450. E. of Bridlip, near Cheltenham.

929. Limestone: flaggy, called "Stonesfield slate."
N. 1461. E. of Bridlip, near Cheltenham.

930. Vacant.

931. Vacant.

932. Pisolitic limestone.
N. 1344. From the "Craie pisolitique," or Maestricht beds, near Vigny, N. of Meulan, N.W. of Paris.

933. Oolitic limestone: very neatly and distinctly oolite, best stone.
N. 1456. From top of the Inferior oolite, between Bridlip and Leckhampton, Cheltenham.

Red Numbers. Name and Locality, &c.

934. Oolitic limestone with fossil shells.
N. 1157. From top of the Inferior oolite, between Bridlip and Leckhampton, Cheltenham.

935. Limestone: white, shelly.
N. 1243. From the "Craie pisolitique" or Maestricht chalk, Vigny, N. of Meulan, N.W. of Paris.

936. Pisolitic limestone: called "Pea grit," Inferior oolite.
N. 1460. Leckhampton, Cheltenham.

937. Pisolitic limestone: called "Pea grit," Inferior oolite.
N. 1465. Leckhampton, Cheltenham.

938. Pisolitic limestone: called "Pea grit," Inferior oolite.
N. 1464. Leckhampton, Cheltenham.

939. Pisolitic limestone: called "Pea grit," Inferior oolite.
N. 1454. Leckhampton, Cheltenham.

940. Oolitic limestone passing into Pea grit.
N. 1459. Leckhampton, Cheltenham.

941. Oolite, used in building new Museum in Trinity College, Dublin.
From Caen, Normandy.
Presented by T. Newenham Deane, Esq.

942. Oolite, Portland stone, used in building new Museum in Trinity College, Dublin.
From Portland.
Presented by T. Newenham Deane, Esq.

943. Oolite, used in building new Museum in Trinity College, Dublin.
From Caen, Normandy.
Presented by T. Newenham Deane, Esq.

944. Oolite: fine grained, the oolitic structure scarcely perceptible, used in building new Museum in Trinity College, Dublin.
Aubyne stone, Normandy.
Presented by T. Newenham Deane, Esq.

945. Oolitic limestone, from the Carboniferous limestone.
N. 4913. Carrick Hill, Edenderry, King's Co.
Collected by G. V. DuNoyer.

946. Oolitic limestone, from the Carboniferous limestone.
N. 4914. Carrick Hill, Edenderry, King's Co.
Collected by G. V. DuNoyer.

947. Oolitic limestone.
N. 4915. From the Carboniferous limestone, Fahy, Edenderry, King's Co.
Collected by G. V. DuNoyer.

948. Oolitic limestone.
N. 4917. From the Carboniferous limestone, Fahy, Edenderry, King's Co.
Collected by G. V. DuNoyer.

Red Numbers. Name and Locality, &c.

949. Oolitic limestone: dark grey, but as distinctly oolitic as No. 933.
From the Carboniferous limestone of Moyne, Killaloe, Co. Mayo.
Collected by F. J. Foot.

950. Oolitic limestone: dark grey, but as distinctly oolitic as No. 933, large block.
N. 1004.
From the Carboniferous limestone of Moyne, Killaloe, Co. Mayo.
Collected by F. J. Foot.

951. Limestone: dark grey, crystalline, with parts of two fissures that have been filled by crystalline calcite.
From the Carboniferous limestone at Kilbline, Co. Kilkenny.
Collected by R. Martin.

952. Limestone: dark brown, with black chert.
N. 1359. From the Carboniferous limestone, Red Cow Village, N.W. of Dublin.
Collected by G. V. DuNoyer.

953. Limestone: dark brown, with black chert.
N. 1360. From the Carboniferous limestone, Red Cow Village, N.W. of Dublin.
Collected by G. V. DuNoyer.

954. Limestone: dark brown, with black chert.
N. 1365. From the Carboniferous limestone, Red Cow Village, N.W. of Dublin.
Collected by G. V. DuNoyer.

955. Limestone: dark brown, with black chert.
N. 1364. From the Carboniferous limestone, Red Cow Village, N.W. of Dublin.
Collected by G. V. DuNoyer.

956. Limestone: dark brown, with black chert.
N. 1368. From the Carboniferous limestone, Red Cow Village, N.W. of Dublin.
Collected by G. V. DuNoyer.

957. Limestone containing small crystals of black quartz.
Quarry Lodge, near Greengullia, E. of Killarney, Co. Kerry.
Collected by G. V. DuNoyer.

958. Limestone containing small crystals of black quartz.
Quarry Lodge, near Greengullia, E. of Killarney, Co. Kerry.
Collected by G. V. DuNoyer.

959. Chalk flint.
From the Co. Antrim?

960. Chalk (or White limestone), with flints.
Colin Glen, near Belfast.
Collected by A. Wyley.

Red Numbers. Name and Locality, &c.

961. Vacant.

962. Limestone, full of small rounded quartz pebbles.
J. 859. Kerloge, a little S. of Wexford, where the Carboniferous limestone rests against old Cambrian cliffs, with quartz and quartz rocks in them.

963. Limestone, full of small rounded quartz pebbles.
J. 858. Kerloge, a little S. of Wexford, where the Carboniferous limestone rests against old Cambrian cliffs, with quartz and quartz rocks in them.

964. Black limestone, containing an angular slab of silvery mica
K. 361. schist, six inches across.
From the quarries at Miltown, S. of Dublin.
Presented by Mr. H. W. Carroll.

965. Black limestone, containing small angular fragments of
K. 228. granite and granite sand.
From the quarries at Milltown. S. of Dublin.
Presented by Mr. H. W. Carroll.

966. Black limestone, containing a small angular slab of silvery
K. 229. mica schist.
From the quarries at Milltown, S. of Dublin.
Presented by Mr. H. W. Carroll.

967. Black limestone, containing small angular fragments of
K. 227. granite and granite sand.
From the quarries at Milltown, S. of Dublin.
Presented by Mr. H. W. Carroll.

968. Black limestone, containing angular lumps of granite.
J. 895. From the quarries near Crumlin, Co. Dublin.

969. Black limestone, containing angular lumps of granite.
From the quarries near Crumlin, Co. Dublin.

970. Limestone, dark, grey, splintery (Coniston limestone).
K. 850. From near Low Wood, Windermere, Westmoreland.

971. Vacant.

972. Cornstone: concretionary limestone in a mass of sandstone,
G. 956. and more or less mixed with sand or clay.
From the Old Red Sandstone between Shehy Mountain and Owen Hill, W. of Dunmanway, Co. Cork.
Collected by J. Flanagan.

973. Cornstone (see 972).
N. 989. From the Old Red Sandstone near Inchigeelagh, Co. Cork.
Collected by G. V. DuNoyer.

974. Cornstone.
G. 4930. From the E. side of Smerwick Harbour, Dingle.
Collected by J. Flanagan.

975. Cornstone.
G. 4913. From the E. side of Smerwick Harbour, Dingle.
Collected by J. Flanagan.

Red Numbers.	Name and Locality, &c.

976. Cornstone.
G. 4931. From the E. side of Smerwick Harbour, Dingle.
Collected by J. Flanagan.

977. Cornstone, with pebbles, &c.
K. 231. From the Old Red Sandstone N. of Templemore.

978. Cornstone.
From the Permian rocks, Frankley Beaches, Staffordshire.

979. Cornstone.
From the Permian rocks, Frankley Beaches, Staffordshire.

980. Cornstone.
N. 2980. From the Old Red Sandstone of S. Wales, near Abergavenny.

981. Cornstone.
N. 8783. From the Old Red Sandstone E. of Thurles.
Collected by A. B. Wynne.

982. Cornstone.
N. 7386. From the Old Red Sandstone E. of Thurles.
Collected by A. B. Wynne.

983. Cornstone (see 972), large specimen.
N. 991. From the Old Red Sandstone, near Inchigeelagh, Co. Cork.
Collected by G. V. DuNoyer.

984. Cornstone (see 972), large specimen.
N. 992. From the Old Red Sandstone, near Inchigeelagh, Co. Cork.
Collected by G. V. DuNoyer.

[Numbers 985 and 986 reserved for future specimens.]

DOLOMITES, OR MAGNESIAN LIMESTONE.

987. Magnesian limestone: yellow earthy dolomite.
N. 1355. From the Permian beds at Ardtrea, Co. Tyrone.

988. Magnesian limestone: yellow hard dolomite, distinctly
N. 1354. oolitic (dolomitic oolite or oolitic dolomite).
From the Permian beds, Ardtrea, Co. Tyrone.

989. Magnesian limestone: dolomite, long narrow parallel, finger-shaped concretions.
Permian beds of Dunbar.
Geological Survey of Great Britain.

990. Magnesian limestone (dolomitic). Similar concretions to 989, but radiating.
From Permian beds of Dunbar.
Geological Survey of Great Britain.

991. Like 990, but locality and collector unknown.

992. Magnesian limestone or dolomite, crystalline.
J. 135. From a lode called Killeen Mine, S. side of Bantry Bay.

Red Numbers.	Name and Locality, &c.

993. Magnesian limestone (dolomite), white, cavernous; cavities lined with crystals of Bitter spar.
From the Carboniferous limestone, Mallow, Co. Cork.
Collected by G. V. DuNoyer.

994. K. 409. Magnesian limestone, dolomite, beautifully crystalline, nearly white.
From the top of the Carboniferous limestone, just below the base of the Coal Measure shales, Rahcandoran, Co. Carlow.
Presented by Rev. Professor Haughton.

995. N. 8196. Dolomite with cavities full of crystals of Bitter spar.
From the Carboniferous limestone on the shore of Malahide, Co. Dublin.

996. Dolomite: Carboniferous limestone.
From Osgathorpe, near Ashby de la Zouche, Leicestershire.
Geological Survey of Great Britain.

997. Dolomite: cavities with Bitter spar.
From Carboniferous limestone, Howth, Co. Dublin.
Collected by G. V. DuNoyer.

[Numbers 998 and 999 reserved for future specimens.]

GYPSUMS.

1000. N. 1255. Gypsum: sulphate of lime, granular, in thin layers of small crystalline granules.
From tertiary beds of Montmartre, Paris.

1001. N. 1253. Gypsum: sulphate of lime, Selenite. Part of the bed 1000, crossed by crystalline plates of Selenite (which have slightly disturbed the layers of crystalline granules), in the same way that the concentric coats in stalactites, &c., are crossed by crystalline plates, striking through several layers.
Montmartre, Paris.

1002. N. 1256. Gypsum, containing Menilite? (siliceous concretion, like flint in limestone.)
Montmartre, Paris.

1003. Gypsum: fibrous veins in red marl.
New Red Sandstone, Syston, Leicestershire.
Geological Survey of Great Britain.

1004. Gypsum: gray, laminated.
From Lough Allen.
Presented by —— ?

[Numbers 1005 to 1009 reserved for future specimens.]

COALS.*

Red Numbers.	Name and Locality, &c.
1010.	Coal, containing layers of dark carbonaceous shale (or batt.) Taken from the Coal hod.
1011. N. 3229.	Coal, interstratified with fine grained white sandstone, called by colliers, "Rock and Rig." Grace Mary Colliery, S. Staffordshire.
1012. N. 3238.	Coal, containing crystalline mass of white carbonate of lime. Grace Mary Colliery, S. Staffordshire.
1013. N. 3239.	Coal, interstratified with fine grained white sandstone, called by colliers, "Rock and Rig." Grace Mary Colliery, S. Staffordshire.
1014. N. 3235.	Coal, interstratified with fine grained sandstone, called by colliers, "Rock and Rig." Grace Mary Colliery, S. Staffordshire.
1015. N. 3253.	Coal, interstratified with fine grained sandstone, called by colliers, "Rock and Rig." Grace Mary Colliery, S. Staffordshire.
1016.	Coal: a lump showing the lamination and the "cleet" or "slyne," and "the end" of the coal. Taken at random from Coal hod.
1017.	Black Carbonaceous substance. From river, near Annascaul, Co. Kerry. Collected by A. B. Wynne.
1018.	Coal: very pyritous. From the Wealden Beds of the Isle of Wight. Geological Survey of Great Britain.
1019.	Lignite. From the pipe clay pits, near Caher, Co. Tipperary.
1020.	Lignite. From the pipe clay pits, near Caher, Co. Tipperary.
1021.	Coal, with singular concretionary structure, somewhat resembling "cone in cone." From the S. Welsh Coalfield. Purchased from Mr. Glennon.
1022. K. 439.	Lignite, in small pieces. From the tertiary beds, between the basaltic flows, near the top of the cliff, over the Giant's Causeway, Co. Antrim.

* A large topographical collection of Coals in common use will be seen in the N. Gallery.

PART II.

COLLECTION OF TYPICAL EUROPEAN ROCKS, CHIEFLY IGNEOUS AND METAMORPHIC.

PURCHASED FROM DR. A. KRANZ, OF BONN.

The red painted numbers on these specimens are the same as those on the small gummed labels, the additional painting being merely to guard against the loss or erasure of the label.

The following descriptions are copied from the printed and written labels supplied by Dr. Kranz, without any alteration, except the correction of a few obvious errors or misprints.

The picked specimens only are shown in the glass-case, the duplicates and less important varieties, marked with a D under the number, are in the drawers of the table cases.

Red Numbers.	Name and Locality, &c.
1.	Pietra paesina. (Altered Apennine limestone.) From Belfort, Tuscany.
2. D.	Calcarea pisolitico. Dolomite. (Altered Apennine limestone.) From Castellina, Tuscany.
3. D.	Calcarea rosso-ammonitico. (Altered Apennine limestone.) From Monte Calvi, Tuscany.
4. D.	Jura Dolomit. Dolomie Jurassique. Dolomitic Oolite (altered Jura limestone) From Rabenstein, in Bavaria.
5.	Oxfordthon, Ober brauner Jura. Argile Oxfordiene. Oxford clay (altered into whet slate). From Guttanen, Switzerland.

Red Numbers.	Name and Locality, &c.
6. D	Keuperdolomit. Altered keuper limestone. From Faulenberg, near Würzburg.
7. D.	Dolomite. Muschelkalk (altered). Calcaire conchylien. From Heidelberg.
8.	Arkose (de Bonnard). (Altered New Red Sandstone). From Lapoirie, Dpt. des Vosges.
9.	Bunter Sandstein (columnar). Grès bigarré. New Red Sandstone, (altered by Basalt). From Büdingen, in Hesse.
10. D.	Rauchwacke, Zechstein Dolomit. Dolomie pénéenne. Cavernous Magnesian limestone (altered Permian limestone). From Eisleben.
11. D.	Zechstein Dolomit. Etage Permien d'Orbigny. Permian Magnesian limestone (altered Permian limestone) From Poessneck, in Thuringia.
12. D.	Aelterer Dolomit. Dolomite Devonéen. (Altered Devonian limestone.) From Biedermark, in the valley of the Lahn.
13. D	Devonischer Dolomit. Dolomite Devonéen. (Altered Devonian limestone.) From Unkel, near Bonn.
14. D.	Devonischer Dolomit. Dolomite Devonéen. (Altered Devonian marl.) From Unkel, near Bonn.
15. D.	Thonschiefer. Ardoise. Devonian clayslate (a little altered). From Caub, on the Rhine.
16. D.	Unter-Silurische Schichten. Terrain silurien inférieur. Lower silurian formation (altered clayslate) From Ilmenau, Thuringia.
17. D.	Griffelschiefer. Schiste luisant bacillaire. (Altered clayslate.) From Sonnenberg, in Thuringia.

Red Numbers. Name and Locality, &c.

18. Chiastolith-Schiefer.
Macline, Schiste maclé.
(Altered clayslate).
From Gefrees, in Bavaria.

19. D. Alaunschiefer (Werner).
Schiste alunifère.
Alum slate (Jameson).
Graptolite slate, with Monograpsus convolutus and Hallii of Geinitz.
From Beraun, Bohemia.

20. D Alaunschiefer (Werner).
Schiste alunifère.
Alum slate (Jameson).
From Reichenbach, in the Voigtland.

21. D. Alaunschiefer (Werner).
Schiste alunifère.
Alum slate (Jameson).
From Reichenbach, in the Voigtland.

22. 23. 24. Decomposed and thrown away.

25. D. Kieselschiefer.
Schiste siliceux.
Siliceous slate.
From Sellenberg, in the Hartz Mountains.

26. D. Kieselschiefer.
Schiste siliceux.
Siliceous slate.
From Frankenberg, in Saxony.

27. D. Kieselschiefer.
Schiste siliceux.
Siliceous slate (Lydianstone).
From Wittgendorf, Saxony.

28. D. Kieselschiefer.
Schiste siliceux.
Siliceous slate.
From Boolweg, near Osterode, in the Hartz.

29. D. Kieselschiefer.
Schiste siliceux.
Siliceous slate (with quartz veins).
From Weilburg, in Nassau.

30. D. Kieselschiefer.
Schiste siliceux.
Siliceous slate (with Wavellite).
From Frankenberg, in Saxony.

Red Numbers.	Name and Locality, &c.

31. Kieselschiefer.
D. Schiste siliceux.
Siliceous slate (with Variolite).
From Merbach, Saxony.

32. Wetzschiefer, Novaculit.
Schiste coticulé.
Whet slate.
From Chamouny.

33. Wetzschiefer, Novaculit.
Schiste coticulé.
Whet slate.
From Chamouny.

34. Wetzschiefer.
D. Schiste coticulé.
Whetstone slate.
From Seiffersdorf, near Freiberg.

35. Wetzschiefer.
D. Schiste coticulé.
Whetstone slate.
From Seiffersdorf, near Freiberg.

36. Wetzschiefer.
Schiste coticulé.
Whet slate.
From Recht (Eifel).

37. Wetzschiefer; Novaculit.
D. Schiste coticulé.
Whet slate.
From Linz, on the Rhine.

38. Ottrelith in Wetzschiefer.
D. (Ottrelite slate).
From Ottrez, in Limburg.

39. Ottrelite slate.
D. From Serravezza, Piedmont.

40. Spilosit (Zinken).
Durch Hyperstehnfels veränderte, devonische Schiefer.
(Devonian slate, altered by Hypersthene rock.)
From Herstein, Birkenfeld (Oldenburg).

41. Spilosit (Zinken).
Durch Hyperstehnfels veränderte, devonische Schiefer.
(Devonian slate, altered by Hypersthene rock.)
From Herstein, Birkenfeld (Oldenburg).

42. Chloritschiefer.
Chlorite schisteux.
Chlorite schist.
From Pfitsch-Thal, in Tyrol.

Red Numbers. | Name and Locality, &c.

43. Chloritschiefer.
Chlorite schisteux.
Chlorite schist (with Epidote).
From Pfitsch-Thal, in Tyrol.

44. Chloritschiefer.
Chlorite schisteux.
Chlorite schist (with garnet).
From Pfitsch-Thal, in Tyrol.

45. Chloritschiefer.
Chlorite schisteux.
Chlorite schist (with magnetic iron).
From Pfitsch-Thal, in Tyrol.

46. Chloritschiefer.
D. Chlorite schisteux.
Chlorite schist (with hornblende).
From Maxen, in Saxony.

47. Talkschiefer.
Schiste talqueux, Stéachiste (Brongniart).
Talcose schist.
From Greiner, in Tyrol.

48. Talkschiefer.
D. Schiste talqueux, Stéaschiste (Brongniart).
Talcose schist.
From Greiner, in Tyrol.

49. Talkschiefer.
D. Schiste talqueux.
Talc schist.
From Wernersdorf, Moravia.

50. Talkschiefer.
D. Schiste talqueux.
Talc schist.
From Rudolphstein, in Bavaria.

51. Talkschiefer.
D. Schiste talqueux.
Talc schist.
From Mount Gothard, Switzerland.

52. Talk (Werner).
Talc (Haüy).
Prismatic Talc Mica (Jameson).
From Greiner, in Tyrol.

53. Talk (Werner).
Talc.
From Frankenstein, Silesia.

54. Topfstein, lapis comensis (Pliny.)
Talc ollaire (Haüy).
Potstone (in the Swiss Romance language, Scaleigl).
From Dissentis, in the Grisons.

Red Numbers. | Name and Locality, &c.

55. Schaalstein.
Schaalstone.
Spilite (altered clayslate, with carb. lime.)
From Weilburg, in Nassau.

56. Schaalstein.
Spilite.
From Dillenburg, Nassau.

57. D. Schaalstein.
Spilite.
From Chamouni.

58. Schaalstein.
Spilite.
From Dietz, in Nassau.

59. Schaalstein.
Spilite.
From Dietz, in Nassau.

60. D. Schaalstein.
Spilite.
From Dietz, in Nassau.

61. D. Schaalstein.
Spilite (chloritic).
From Rübeland, in the Hartz.

62. Schaalstein.
Spilite (dioritic).
From Faucogney, Dept. of Haute Saone.

63. D. Schaalstein Mandelstein.
Amygdaloidal Schaalstone.
Spilite amygdaloïde.
From Weilburg, Nassau.

64. Schaalstein porphyr.
Schaalstone porphyry (crystals of feldspar).
Spilite porphyroide.
From Balduinstein, in Nassau.

65. D. Itabirit.
Eisenglimmerschiefer.
(Peroxide and protoxide of iron with quartz.)
From Villa Ricca, Brazil.

66. Itabirit.
Eisenglimmerschiefer.
(Peroxide and protoxide of iron with quartz).
From Villa Ricca, Brazil.

67. Itacolumit.
Gelenkquarz.
Flexible quartz rock (becomes flexible from fine intermixed particles of mica).
From Itacolumi, Brazil.

Red Numbers. Name and Locality, &c.

68. Quarzfels (Bed formed in Gneiss).
D. Quarzite.
Quartz rock.
From Spitalwald, near Freiberg.

69. Quarzfels.
D. Quarzite.
Quartz rock.
From Marienberg, near Bonn.

70. Quarzfels.
D. Quarzite.
Quartz rock.
From Dillenburg, Nassau.

71. Quarzfels.
D. Quarzite.
Quartz rock.
From Hartzburg, Hartz.

72. Quarzfels.
D. Quarzite.
Quartz rock
From Royalston, Massachusets.

73. Quarzfels.
D. Quarzite.
Quartz rock (containing gold).
From California (Sacramento river).

74. Quarzfels.
D. Quarzite.
Quartz rock (ferruginous).
From California.

75. Rosenquarz.
D. Quarz rose.
Rose quartz rock (coloured by manganese).
From Rabenstein, in Bavaria.

76. Quarzschiefer.
Quarzite schisteux.
From Spitalwald, near Freiberg.

77. Spodumen rock.
D. Lithion spodumen.
Triphane.
From Stirling, Massachusets.

78. Mangankiesel (Rhodonit),
Manganèse oxydè silicifère.
Silicate of manganese rock.
From Elbingerode, in the Hartz.

79. Bandjaspis.
Jaspe rubané.
Striped jasper rock.
From Lerbach, in the Hartz.

Red Numbers.	Name and Locality, &c.
80. D.	Bandjaspis. Jaspe rubané. Striped jasper rock. From Lerbach, in the Hartz.
81. D.	Apatit (Werner). Chaux phosphateé (Haüy). Rhombohedral apatite (Jameson), (apatite rock) apatite and quartz. From Schlackenwalde, in Bohemia.
82.	Moroxit. Apatite rock (apatite, feldspar, carb. lime. and magnetic pyrites). Apatite verte. From Hammond, St. Laurence city, New York.
83. D.	Topasfels. Topazogène. Topazrock (quartz, schorl, and topaz). From Schneckenstein, in Saxony.
84. D.	Topasfels. Topazogène. Topazrock. From Schneckenstein, in Saxony.
85.	Schörlschiefer. Schorl schisteux. Schorl schist (quartz and schorl). From Eibenstock, in Saxony.
86.	Granulit, Weisstein. Leptinite. White stone (fine grained feldspar and quartz, often with garnet.) From Etzdorf, in Saxony.
87.	Granulit, Weisstein. Leptinite. White stone. From Mitweida, Saxony.
88. D.	Granulit, Weisstein ; mit cyanit. Leptinite. White stone, with cyanite. From Röhrsdorf, near Chemnitz.
89. D.	Granulit, Weisstein ; mit cyanit. Leptinite. White stone, with cyanite. From Röhrsdorf, near Chemnitz.
90. D.	Granulit, Weisstein. Leptinite. White stone. From St. Etienne, Vosges.

Red Numbers.	Name and Locality, &c.
91.	Gneus, Gneiss. Feldspar, mica, quartz, slaty. From Freiberg, in Saxony.
92.	Gneus, Gneiss. From Freiberg, in Saxony.
93.	Gneus, Gneiss. From Annaberg, Saxony.
94. D.	Gneus, Gneiss. From Rauvir, Salzburg.
95. D.	Gneus, Gneiss. From the Fichtelgebirge, Bavaria.
96. D.	Gneus, Gneiss. From Freiberg, in Saxony.
97. D.	Gneus, Gneiss. From Nossen, Saxony.
98. D.	Gneus, Gneiss. From Nossen, Saxony.
99. D.	Gneus, Gneiss. From Maitzenthal, near Ilsenburg, Hartz.
100. D.	Gneus, Gneiss. Hornblendic gneiss. From Hof, Bavaria.
101. D.	Gneus, Gneiss. Hornblendic gneiss. From Hof, Bavaria.
102. D.	Gneus, Gneiss. Ferruginous. From between Valorsina and Trient, Tyrol.
103. D.	Gneus, Gneiss. With tourmaline, in contact with chlorite slate. From Airolo, Canton Tessin.
104. D.	Gneus, Gneiss. With precious garnet, Almandine gneiss. From Wittichên, Black Forest.
105. D.	Gneus, Gneiss. Dichroite gneiss. From Steinach, Kintzig valley, Baden.
106. D.	Gneus, Gneiss. Dichroite gneiss. From Bodenmais, Bavaria.
107. D.	Glimmerschiefer. Mica schiste. Mica slate (quarz and mica slate). From Bräunsdorf, in Saxony.

Red Numbers.	Name and Locality, &c.
108. D.	Glimmerschiefer. Mica schiste. Mica slate (with garnet). From Bräunsdorf, in Saxony.
109.	Glimmerschiefer. Mica schiste. Mica slate (with garnet). From Miltitz, Saxony.
110. D.	Glimmerschiefer. Mica schiste. Mica slate. From Miltitz, Saxony.
111.	Glimmerschiefer. Mica schiste. Mica slate. From Mount Brenner, Tyrol.
112.	Glimmerschiefer. Mica schiste. Mica slate. From Krieglach, Styria.
113. D.	Glimmerschiefer. Mica schiste. Mica slate (with garnet). From Krieglach, Styria.
114.	Glimmerschiefer. Mica schiste. Mica slate (with garnet). From Airolo, Switzerland.
115. D.	Glimmerschiefer. Mica schiste. Mica slate (with garnet). From St. Gothard, Switzerland.
116. D.	Glimmerschiefer. Mica schiste. Mica slate (conglomerate). From Dent de Damon, towards Vevay, Switzerland.
117. D.	Glimmerschiefer. Mica schiste. Mica slate (decomposed). From Leutershausen, near Heidelberg.
118. D.	Flick und Knotenschiefer. Fruchtschiefer. Proteolite, in part (mica slate with hornbleude). From Weesenstein, in Saxony.

Red Numbers. | Name and Locality, &c.

119. Fleck und Knotenschiefer.
D. Fruchtschiefer.
Proteolite, in part.
From Weesenstein, in Saxony.

120. Fleck und Knotenschiefer.
D. Fruchtschiefer.
Proteolite, in part.
From Weesenstein, in Saxony.

121. Glimmerschiefer.
Mica schiste.
Mica slate (with andalusite).
From Lisenz, Tyrol.

122. Glimmerschiefer.
Mica schiste.
Mica slate (with schorl or tourmaline).
From Leoben, Styria.

123. Glimmerschiefer.
D. Mica schiste.
Mica slate (vein of ankerite and chrome mica).
From Pfitsch valley, Tyrol.

124. Glimmerschiefer.
D. Mica schiste.
Mica slate (veins of purple copper).
From Monte Cative, Tuscany.

125. Rothspiesglaserz (Werner).
D. Antimoine oxydé sulfuré (Haüy).
Prismatic antimony-blende (Jameson).
From Bräunsdorf, near Freiberg.

126. Dichtes Grauspiesglaserz (Werner).
D. Antimoine sulfuré compacte.
Compact gray antimony-ore (Jameson).
From Gold Kronach, Bavaria.

127. Blende (Werner).
D. Zinc sulfuré (Haüy).
Dodecahedral zinc-blende (Jameson), (vein in gneiss).
From Freiberg.

128. Arsenikkies (Werner) Mispickel.
D. Arsenical iron (Philips).
Fer arsenical (Haüy), (vein in mica slate).
From Freiberg.

129. Eisenglimmer.
D. Fer oligiste ecailleux.
Iron mica (vein in mica slate).
From iron mine at Rio, in Elba.

Red Numbers.	Name and Locality, &c.

130. Eisenglimmer.
D. Fer oligiste ecailleux.
Iron mica (veins in mica slate).
From Monte Calamita, Elba Island.

131. Rotheisenstein, Eisenoxyd.
D. Fer oligiste.
Red iron ore, haematite (veins in schaalstein).
From Weilburg, Nassau.

132. Rotheisenstein, Eisenoxyd.
D. Fer oligiste.
Red iron ore, haematite (veins in mica slate).
From Irgang, near Platten, in Bohemia.

133. Spatheisenstein.
D. Fer oxydé carbonaté (Haüy).
Spathic iron (veins in clay slate).
From Marienberg, near Bonn.

134. Brauneisenstein.
D. Fer oxydé hydraté.
Brown iron ore (veins in Lower Devonian sandstone).
From Horhausen, near Neuwied.

135. Dichter Brauneisenstein.
D. Fer oxydé hydraté compact (Dufrenoy).
Compact brown iron ore (veins in gneiss).
From Hof, Bavaria. (Decomposed carb. of iron and iron pyrites).

136. Dichter Brauneisenstein.
D. Fer oxydé hydraté compact (Dufrenoy).
Compact brown iron ore (veins in mica slate).
From Schwarzenberg, Saxony.

137. Dichter Brauneisenstein.
D. Fer oxydé hydraté compact (Dufrenoy).
Compact brown iron ore (veins in Devonian sandstone).
From Siegen.

138. Dichter Brauneisenstein.
D. Fer oxydé hydraté compact (Dufrenoy).
Compact brown iron ore and chalcedony (veins in metamorphic graywacke slate).
From Naila, Bavaria.

139. Hartmanganerz.
D. Manganèse oxydé.
Black manganese-ore (Jameson), and brown iron ore (vein in mica slate).
From Langeberg, near Schwarzenberg.

140. Smirgel (Werner).
D. Corindon granulaire ferrifère (Haüy).
Emery (Jameson), (vein in mica slate).
From Naxos.

Red Numbers.	Name and Locality, &c.
141. D.	Fibrous quartz and amethyst. Veins in mica slate. From Wiesenbad, Saxony.
142. D.	Flusspath (Werner). Chaux fluatée (Haüy). Octahedral fluor (Jameson), with galena (veins in gneiss) From Freiberg.
143. D.	Speckstein (Werner), steatit. Talc steatite (Haüy). Steatite (Jameson), soap-stone (vein in mica slate). From Wunsiedel, in Bavaria.
144.	Greisen (Werner). Hyalomicte (quartz and mica). From Zinnwald, in Bohemia.
145.	Greisen (Werner). Hyalomicte. From Zinnwald, in Bohemia.
146.	Molybdaenglanz Wasserblei (Werner). Molybdène sulfuré (Haüy). Sulphuret of molybdenum (Jameson), in gneiss. From Altenberg, in Saxony.
147. D.	Greisen. Hyalomicte, with iron pyrites. From Ehrenfriedersdorf, Saxony.
148.	Granit. Granite. From Baveno, Piedmont.
149.	Granit. Granite. From Cherbourg.
150.	Granit. From Bautzen, in Saxony.
151. D.	Granit. From Bautzen, in Saxony.
152.	Granit. Granite. From Kornberg in the Fichtelgebirge.
153. D.	Granit. Granite. From Kornberg in the Fichtelgebirge.
154. D.	Granit. Granite (oligoclase granite). From Götheborg, Sweden.
155. D.	Granit. Granite (oligoclase granite). From Götheborg, Sweden.

Red Numbers. Name and Locality, &c.

156. Granit.
D. Granite.
From Neustadt on the Hartz (The Brocken).

157. Granit.
Granite.
From Gerdarmer, Department des Vosges.

158. Granit.
D. Granite, with some oligoclase.
From Breitenbrunn, Saxony.

159. Granit.
Granite.
From Ilsenburg, Hartz.

160. Granit.
D. Granite.
From Ilsenburg, Hartz.

161. Granit.
D. Granite.
From Rhomberg, Hartz.

162. Granit.
Gneiss granite.
Granite.
From Weinheim, near Heidelberg.

163. Granit.
Granite, with Labrador feldspar.
From Schmalenburg, Hartz.

164. Granit.
D. Granite, from touching the gabbro.
From Meineckenberg, near Ilsenburg, Hartz.

165. Granit.
Granite (with Labradorite, from touching the euphotide).
From Meineckenberg, near Ilsenburg, Hartz.

166. Granit.
D. Granite, in contact with euphotide.
From Radauthal, Hartz.

167. Granit.
D. Granite, decomposing.
From Schwarzenberg, Saxony.

168. Granit.
Granite, coarse grained.
From Meissen, Saxony.

169. Granit.
Granite (coarse and fine grained).
From Heidelberg, on the Neckar.

170. Granit.
D. Granite (fine grained).
From Neustadt, in the Hartz.

Red Numbers. | Name and Locality, &c.

171. Granit.
D.
Granite (fine grained).
From Auerbach, Hesse.

172. Granit.
Granite (fine grained).
From Wittichen, Black Forest.

173. Granit.
Granite (fine grained).
From Eckerthal, in the Hartz.

174. Granit.
D.
Granite (fine grained).
From Andreasberg, Hartz.

175. Granit.
D.
Granite (gangue-granite, with crystals of feldspar in quartz).
From St. Pietra, Elba.

176. Auralit in granite.
D.
From Abo, Finland.

177. Granit.
D.
Granite (gneissose granite).
From Auerbach, Hesse.

178. Granit.
Granite (porphyritic), with scapolite.
From the Vosges Mountains.

179. Granit.
D.
Granite (porphyritic).
From the Fichtelgebirge, Neubau.

180. Granit.
D.
Granite (hornblende granite).
From Karingbrikka, Sweden.

181. Granit.
D.
Granite (coarse grained, with gadolinite).
From Fahlun, Sweden.

182. Granit.
D.
Granite (schorl granite, with some beryl).
From Geyer, Saxony.

183. Schriftgranit.
D.
Granit graphique.
Graphic granite.
From Ilmenau.

184. Schriftgranit.
Granit graphique.
Graphic granite.
From Maulbach, Thuringia.

185. Schriftgranit.
Granit graphique.
From Zwiesel, Bavaria.

Red Numbers.	Name and Locality, &c.

186. Granit (mit blumigen feldspath).
D. Granite (with flowery feldspar).
From Breitenbrunn, Saxony.

187. Granit.
D. Granite (with spodumene).
From Utoe, Sweden.

188. Granit.
D. Granite (with vein of purple copper).
From Bristol Mine, Connecticut.

189. Granit.
D. Granite (very coarse, forming lodes in normal granite, with yttrotantalite).
From Ytterby, in Sweden.

190. Granit.
D. Granite feldspar.
From Arendal, Norway.

191. Granit.
D. Granite (feldspar and carb. lime, out of the granite).
From Arendal, Norway.

192. Oligoklas (Breithaupt).
D. Natron-Spodumen (Berzelius).
From the granite of Ytterby, in Sweden.

193. Bergkrystall.
D. Quarz hyalin.
Rockcrystal (out of the granite of Järischau, in Silesia).

194. Gemeiner beryll.
D. Emeraude, beryl.
Common beryl, out of the granite of Limoges (Dept. Hte. Vienne).

195. Zoisit (Werner).
D. Epidote (Haüy).
Zoisite (Jameson) out of the granite from Gefrees, in Bavaria.

196. Titaneisen, Axotomes Eisenerz.
D. Fer oxidulé, titanifère.
Titaniferous iron, and feldspar, from the granite of Krageroe, Norway.

197. Lepidolith, Lithionglimmer.
D. Lithia mica, from the granite of Rozena, near Hradisko in Moravia.

198. Decomposing granite.
D. From Aue, in Saxony.

199. Kaolin, Porzellanerde (Werner).
D. Feldspath decomposé.
Porcelain earth (decomposed granite).
From Aue, in Saxony.

Red Numbers.	Name and Locality, &c.
200. D.	Kaolin (Werner). Feldspath decomposé. Porcelain earth (decomposed granite). From Passau, Bavaria.
201.	Beresit (G. Rose). Granite, from Beresowsk, on the Ural.
202.	Protogyn. Protogine. Talcose granite. Chamouny, valley of the Arve, Savoy.
203. D.	Protogyn. Protogine. From the Glacier des Bois, in the valley of the Arve, Savoy.
204. D.	Protogyn. Protogine. Mont Blanc, Savoy.
205.	Protogyn (slaty). Protogine. Chamouny.
206.	Protogyn. Granit talqueux. Protogine. From St. Gothard.
207. D.	Protogyn (and adularia). Granit talqueux. Protogine. From Bourg d'Oisans, Dauphiny.
208. D.	Protogyn (with bissolite and adularia). Granit talqueux. Protogine. From Bourg d'Oisans, Dauphiny.
209. D.	Syenite (Gem. feldspath u. hornblend). Sinaite, (granitic). Common quartz and hornblende. From Darmstadt.
210. D.	Syenite (Gem. feldspath u. hornblend). Sinaite. From Darmstadt, Mühlthal.
211.	Syenite (Gem. feldspath u. hornblend). Sinaite. From Darmstadt, Mühlthal.
212. D.	Syenite (Gem. feldspath u. hornblend). Sinaite. From Eberstadt, Hesse.

Red Numbers.	Name and Locality, &c.
213. D.	Syenite. Sinaite. Granitelle (Saussure). From Corravillers, Department de la Hte., Saono.
214. D.	Syenite (Gem. feldspath u. hornblend). Sinaite. From St. Maurice, Vosges.
215.	Syenite (Gem. feldspath u. hornblend). Sinaite. Common feldspar and hornblende. From St. Maurice, Vosges.
216. D.	Syenit. Syenite. From Plauenschen Grund, near Dresden.
217.	Syenit. Syenite. From Plauenschen Grund, near Dresden.
218. D.	Syenit (Gem. feldspath u. hornblend). Sinaite. Common feldspar and hornblende. From Meissen.
219. D.	Syenit (Gem. feldspath u. hornblend). Sinaite. Common feldspar and hornblende. From Weinheim, near Heidelberg.
220.	Albit syenit (Glocker). Albite syènite. From Galberg, near Boxdorf, in Saxony.
221.	Zirconsyenit. Syenite zirconifère. Zircon syenite. From Frederikswärm, in Norway.
222. D.	Zirconsyenit. Syenite zirconifère. (With elaeolit, fluor spar, &c.) From Brewig, in Norway.
223. D.	Zirconsyenit. Syenite zirconifère. Zircon syenite, with titanic iron. From Brewig, in Norway.
224.	Zirconsyenit. Syenite zirconifere. With asterophyllite. From Brewig, in Norway.

Red Numbers. Name and Locality, &c.

225. Zirconsyenit.
Syenite zirconifere.
With pyrochlore and mica.
From Brewig, in Norway.

226. Syenit porphyr.
Grüner porphyr (Naumann).
(Pegmatit; albit, quartz, hornblende),—(quartz, chlorit, feldspar, sometimes mica.)
From Wurzen, in Saxony.

227. Feldspathporphyr.
Syenitporphyr.
Porphyre feldspathique.
Feldspar porphyry.
From Geising, in Saxony.

228. Feldspathporphyr (eurit, helleflinte, felsitfels).
Porphyre feldspathique.
Feldspar porphyry, with dendrites.
From Eberstadt, Hesse.

229. Feldspathporphyr (felsitfels).
Porphyre feldspathique.
Feldspar porphyry, with dendrites.
From Monte Albero, Elba.

230. D. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry.
From Tharandt, Saxony.

231. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry.
From Elfdalen, Sweden.

232. D. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry.
From Hippeln, near Harsrode, Hartz.

233. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry (quartziferous, with pinite).
From Montagne de Vannes, Vosges.

234. Feldspathporphyr.
Eurite porphyroïde.
Feldspar porphyry (eurite).
From Rochesson, Department de la Hte., Saone.

235. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry (greatly decomposed feldspar).
From Leipzig. ?

Red Numbers. | Name and Locality, &c.

236. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry.
From Harsrode, Hartz.

237. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry.
From Halle.

238. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry (quartziferous).
From Auersberg, in the Hartz.

239. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry (feldspar becoming kaolin).
From Auersberg, Hartz.

240. D. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry.
From Darmstadt.

241. Feldspathporphyr.
Porphyre feldspathique.
Feldspar porphyry (passing into melaphyre).
From Darmstadt.

241. After-kristalle nach feldspath (kohlen sauererkalk), in thonporphyr.
Pseudomorphic crystals of carbonate of lime, in the forms of feldspar, in claystone porphyry.
From Manebach, in Thuringia.

243. D. Quartziferous porphyry breccia, with manganese, out of the porphyry.
From Manebach, Thuringia.

244. D. Hartmanganerz.
Manganèse oxydé.
Black manganese ore.
From Oehrenstück, in Thuringia.

245. D. Hartmanganerz.
Manganèse oxydé.
Black manganese ore (vein in porphyry).
From Oehrenstück, in Thuringia.

246. D. Braunit.
Brachytypous manganese ore (veins in porphyry).
From Ilmenau, in Thuringia.

Red Numbers. Name and Locality, &c.

247. Pyrolusit (Weichmanganerz)
Manganèse oxydé.
Gray oxide of manganese (veins in porphyry).
From Ilmenau, in Thuringia.

248. Pyrolusit (Weichmanganerz.)
Manganèse oxidé.
Gray oxide of manganese (veins in porphyry).
From Ilmenau, in Thuringia.

249. Quarzporphyr.
Porphyre quarzifère.
Quartziferous porphyry.
From Longemer, Vosges.

250. D. Quarzporphyr.
Porphyre quarzifère.
Quartziferous porphyry.
From Laroche, Département des Vosges.

251. D. Quarzporphyr.
Porphyre quarzifère.
Quartziferous porphyry.
From Montaigu (Vosges.)

252. Quarzporphyr.
Porphyre quarzifère.
Quartziferous porphyry.
From Imponnetta, Tuscany.

253. Quarzporphyr.
Porphyre quarzifère.
Quartziferous porphyry.
From Eisenbach, near Schemnitz, Hungary.

254. Quarzporphyr.
Porphyre quarzifère.
Quartziferous porphyry.
From Baden Baden.

255. Quarzporphyr.
Porphyre quarzifère.
Quartziferous porphyry.
From Creuznach.

256. Mühlsteinporphyr.
Porphyre molaire.
Millstone porphyry (porous quartziferous porphyry.)
From Glashütte, near Schemnitz.

257. Mühlsteinporphyr.
Porphyre molaire.
Millstone porphyry.
From Glashütte, near Schemnitz.

258. D. Hornblende porphyr.
Hornblende porphyry.
From Potschappel, Saxony.

Red Numbers.	Name and Locality, &c.
259.	Thonporphyr. Argillophyre. Claystone porphyry (feldspar porphyry). From Hilbersdorf, near Freiberg.
260.	Thonporphyr. Argillophyre. Claystone porphyry. From Ilmenau, Thuringia.
261. D.	Thonporphyr. Argillophyre. Claystone porphyry. From Heidelberg, on the Neckar.
262. D.	Thonporphyr. Argillophyre. Claystone porphyry. From Burgstaedtel, near Dresden.
263. D.	Thonporphyr. Argillophyre. Claystone porphyry. From Heidelberg, on the Neckar.
264.	Thonporphyr. Argillophyre. Claystone porphyry. From Heidelberg, on the Neckar.
265. D.	Thonporphyr. Argillophyre. Claystone porphyry, micaceous. From Schweinsdorf, Saxony.
266. D.	Thonporphyr. Argillophyre. Claystone porphyry. From Himmelfarth mine, near Freiberg.
267. D.	Thonporphyr. Argillophyre. Claystone porphyry. From Nossen, Saxony.
268.	Thonstein (Werner). Claystone. From Hilbersdorf, near Chemnitz.
269. D.	Thonstein (Werner). Claystone. From Hilbersdorf, near Chemnitz.
270.	Thonstein (Werner). Claystone. From Hilbersdorf, near Chemnitz.

Red Numbers. Name and Locality, &c.

271. Hornstein porphyr.
Hornstone porphyry.
From Windberg, Saxony.

272. D. Band porphyr.
Striped porphyry.
From Tharand, Saxony.

273. Kugel porphyr.
Globular porphyry.
From Elgersburg, Thuringia.

274. D. Globules out of the porphyry.
From Tharand, Saxony.

275. Augit porphyr, melaphyr.
Porphyre pyroxénique.
Augite porphyry, micaceous.
From Marienhöhe, near Darmstadt.

276. D. Augit porphyr, glimmerporphyr.
Augite porphyry.
Porphyre pyroxénique, melaphyre.
From Ilmenau, in Thuringia.

277. Augit porphyr, glimmerporphyr.
Augite porphyry.
Porphyre pyroxénique, melaphyre.
From Ilmenau, in Thuringia.

278. Augit porphyr, melaphyr.
Porphyre pyroxénique.
Augite porphyry.
From Radauthal, Hartz.

279. D. Augit porphyr, melaphyr.
Porphyre pyroxénique.
Augite porphyry.
From Val di Fassa, in Süd, Tyrol.

280. D. Graustein.
Pierre grise melaphyre.
Grey stone.
From Plauenschen Grund, near Dresden.

281. Augit porphyr, melaphyr.
Porphyre pyroxénique.
Augite porphyry.
From Oberbrombach, in Birkenfield.

282. D. Augit porphyr.
Melaphyre.
From Rübeland, in the Hartz.

283. Uralit (G. Rose, Pogg. Ann. Jahrg, 20, 27, 21,) in porphyry.
From Predazzo, Tyrol.

Red Numbers. | Name and Locality, &c.

284. Aphanit porphyr.
Aphanitic porphyry.
Diorite compact porphyroïde.
Erom Erbstolln, near Weilburg.

285. Grünstein porphyr.
Porphyre dioritique.
Dioritic porphyry.
From Gastein, Salzburg.

286. Grünstein porphyr.
D. Diorite porphyroïde.
Diorite porphyry, albite crystals in hornblende.
From Blankenburg, in the Hartz.

287. Diorit porphyr.
D. Porphyre dioritique.
Dioritic porphyry.
From Neila, in the Fichtelgebirge.

288. Grünstein.
D. Diorite.
Greenstone.
From Löbau, in Saxony.

289. Grünstein porphyr.
Diorite porphyroïde.
Diorite porphyry, analysed by Delesse.
From Belfahy, Dpt. de la Hte. Saône.

290. Grünstein porphyr.
D. Porphyre dioritique.
Diorite porphyry.
From Le Puitz, Haut Rhin.

291. Grünstein porphyr.
D. Porphyre dioritique.
Diorite porphyry.
From Rübeland, Hartz.

292. Grünstein porphyr.
D. Porphyre dioritique.
Diorite porphyry, crystals of albite and hornblende in compact hornblende.
From Barèges, Pyrenees.

293. Grünstein porphyr.
Porphyre dioritique.
Dioritic porphyry.
From Imponnetta, Tuscany.

294. Grünstein porphyr.
Porphyre dioritique.
Dioritic porphyry, passing into feldspar porphyry.
From Elbingerode, Hartz.

Red Numbers. Name and Locality, &c.

295. Grünstein.
Diorite.
Greenstone.
From Ilmenau, Thuringia.

296. Grünstein.
Diorite.
Greenstone (augite, Labradorite, and oligoclase.)
From Tournay, Hte. Saône, Vosges.

297. D. Diorit, Grünstein.
Greenstone.
From the Lahn-Tunnel, in Weilburg.

298. Grünstein.
Diorite.
Greenstone.
From Löbau, in Saxony.

299. D. Grünstein.
Diorite.
Greenstone.
From the Baste, in the Hartz.

300. D. Grünstein.
Diorite.
Greenstone.
From the Baste, in the Hartz.

301. D. Grünstein.
Diorite.
Greenstone.
From Hohne Kopf, in the Hartz.

302. D. Grünstein.
Diorite.
Greenstone.
From Löbau, in Saxony.

303. D. Grünstein
Diorite.
Greenstone.
From Gersdorf, in Saxony.

304. Grünstein.
Diorite.
Greenstone (slaty).
From Plauen, Saxony.

305. D. Grünstein.
Diorite.
Greenstone (compact).
From Dillenburg, Nassau.

306. D. Grünstein.
Diorite.
Greenstone (compact).
From Hof, Bavaria.

Red Numbers. | Name and Locality, &c

307. Grünstein.
D. Diorite.
Greenstone (compact).
From Arendal, Norway.

308. Hornblende gestein.
Amphibolite grenue.
Hornblende rock.
From Pont Jean, Vosges.

309. Hornblende gestein.
D. Amphibolite grenue.
Hornblende rock.
From Dillenburg.

310. Hornblende gestein.
D. Amphibolite grenue.
Hornblende rock.
From Ober Kotzau, Bavaria.

311. Hornblende gestein.
D. Amphibolite grenue.
Hornblende rock.
From Ilmenau, Thuringia.

312. Hornblende gestein.
D. Amphibolite grenue.
Hornblende rock.
From Arendal, Norway,

313. Hornblende gestein.
D. Amphibolite grenue.
Hornblende rock (with tourmaline and mica.)
From Sterzing, Tyrol.

314. Hornblende gestein.
D. Amphibolite grenue.
Hornblende rock.
From Arendal, Norway.

315. Hornblende gestein..
D. Amphibolite grenue.
Hornblende rock, with melanite garnet.
From Arendal, Norway.

316. Hornblende gestein.
D. Amphibolite grenue.
Hornblende rock (with albite.)
From Snarum, Norway.

317. Gemeine hornblende (Werner).
D. Amphibole lamellaire (Hy.)
Common hornblende (Jameson).
From Schmalzgrube, in Saxony.

Red Numbers.	Name and Locality, &c.

318. Glasiger strahlstein.
D. Amphibole vitreux.
Glassy actinolite.
From Greiner, in the Tyrol.

319. Glasiger strahlstein.
D. Amphibole vitreux.
Glassy actinolite rock.
From Greiner, in the Tyrol.

320. Glasiger strahlstein, kalamit (Werner).
Amphibole vitreux.
Glassy actinolite rock (Jameson).
From Zöptau, in Moravia.

321. Strahlstein (Werner).
D. Actinolite (Haüy).
Actinolite rock (with galena, blende, iron pyrites).
From Campiglia, Tuscany.

322. Strahlstein (Werner).
D. Actinolite (Haüy).
Actinolite rock, with galena and zinc blende.
From Campiglia, Tuscany.

323. Gemeiner strahlstein (Werner).
D. Stralite commun.
Common actinolite rock (Jameson), with dichroite.
From Rio la Marina, Elba.

324. Gemeiner strahlstein (Werner).
D. Stralite commun.
Common actinolite rock (Jameson), with dichroite.
From Rio la Marina, Elba.

325. Sahlit (Werner).
Pyroxène laminaire (Haüy).
Pyramido-prismatic augite rock (Jameson).
From Reichenstein, Silesia.

326. Grünsteinschiefer.
D. Diorite schistoïde.
Greenstone slate.
From Hof, Bavaria.

327. Grünsteinschiefer.
D. Diorite schistoïde.
Greenstone slate.
From Hof, Bavaria.

328. Grünsteinschiefer.
Diorite schistoide.
Greenstone slate.
From Gersdorf, near Freiberg.

Red Numbers. Name and Locality, &c.

329. Hornblendschiefer.
D. Amphibolite schisteux.
Hornblende slate.
From Miltitz, in Saxony.

330. Grünsteinschiefer.
D. Diorite schistoïde.
Greenstone slate.
From Wernersdorf, Moravia.

331. Grünsteinschiefer.
D. Diorite schistoide.
Greenstone slate.
From Airolo, St. Gothard.

332. Grünsteinschiefer.
Diorite schistoide.
Greenstone slate, decomposing.
From Sahla, Sweden.

333. Grünsteinschiefer.
Diorite schistoïde.
Greenstone slate (slickenside).
From Pfitsch-thal, Tyrol.

334. Walkererde (Werner), (aphanit wacke).
Terre à foulon.
Fuller's earth.
From Rosswein, in Saxony.

335. Hornfels.
Leptynite (in part), a compact impure quartz.
From Andreasberg, in the Hartz.

336. Hornfels.
Leptynite (in part).
From Andreasberg, in the Hartz.

337. Hornfels.
Leptynite (in part).
From Andreasberg, in the Hartz.

338. Hornfels.
D. Leptynite (in part).
From Andreasberg, in the Hartz.

339. Eulysit (Axel Erdmann).
D. From Uttervik, near Tunaberg, in Sweden.

340. Pyromerid.
Kugeldiorit (albite and hornblende).
Globular diorite (used to be called Corsican granite).
From Corsica

341. Augitfels.
D. Lherzolith, Lherzolite.
From Vic d'Assos, Dept. de l'Ariège.

Red Numbers. Name and Locality, &c.

342. Augitfels.
Lherzolith, Lherzolite.
From Vic d'Assos, Dept. de l'Ariège.

343. Kokkolith (Werner).
Pyroxène granuleux.
Coccolite (Jameson), (granular pyroxene rock).
From Arendal, in Norway.

344. Granatfels.
D. Grenat en roche.
Garnet rock.
From Greifendorf, near Haynchen.

345. Egeran (Werner).
D. Egerane rock (variety of Vesuvian).
From Schwarzenberg, in Saxony.

346. Kolophonit (garnet rock).
Grenat.
Kolophonite (var. of garnet).
From Arendal, in Norway.

347. Granatfels (allochroit).
D. Grenat en roche.
Garnet rock.
From Hof, Bavaria.

348. Erlan (Breithaupt).
Erlane rock, with egerane.
From Schwarzenberg, in Saxony.

349. Saussurit.
D. Jade de Saussure (Haüy).
Saussurite.
From the Baste, Hartz.

350. Saussurit.
Jade de Saussure (Haüy).
Saussurite.
From the Baste, Hartz.

351. Eklogit.
Eclogite rock (smaragdite and garnet).
From the Tanalp, Carinthia.

352. Omphazit (Werner).
Omphazite.
Omphacite.
From Silberbach, near Hof, Bavaria.

353. Omphazit.
D. Omphacite.
From Fattigau, in the Fichtelgebirge.

354. Omphacitfels (omphacite rock).
Omphazite.
Eklogit.
From Weissenstein, in the Fichtelgebirge.

Red Numbers.	Name and Locality, &c.

355. Omphacitfels.
D. Omphacit.
Eklogit.
From Weissenstein, in the Fichtelgebirge.

356. Antophyllit (Werner).
D. Antholith (Breithaupt).
Anthopbyllite rock.
From Steinbach, in the Fichtelgebirge.

357. Antophyllit (Werner).
Antholith (Breithaupt).
Anthophyllite rock, with rutile and apatite.
From Snarum, Norway.

358. Antophyllit (Werner), Broncit.
D. Antholith (Breithaupt).
Anthophyllite rock.
From Kupferberg, in Bavaria.

359. Variolit.
Variolite.
From Sisteron, on the Durance.

360. Variolit.
Variolite.
From Urbay, Haut Rhin.

361. Epidotfels.
Epidot en roche.
Epidote rock.
From Arendal, Norway.

362. Epidotfels.
D. Epidot en roche.
Vein of epidote rock passing through magnetic iron.
From Schmiedeberg (Silesia).

363. Epidosit (L. Pilla.)
Epidosite.
From Campiglia, in Tuscany.

364. Paulitfels.
D. Hypersthène et Labrador.
Paulite (Hypersthene and Labradorite).
From the Höhlenmühle, near Penig.

365. Paulit (Werner).
Hypersthène (Haüy).
Prismatoidal Schiller-spar (Jameson) out of hypersthene rock.
From Volpersdorf, in the County of Glatz.

366. Hypersthenfels, Paulitfels.
Syénite hypersthénique.
Hypersthene rock, hyperite, or Paulite.
From Herstein, near Kreuznach.

Red Numbers. Name and Locality, &c.

367. Hypersthenfels, Paulitfels.
D. Syénite hypersthenique.
Hypersthene rock.
From Steben, Bavaria.

368. Gabbro, Schillerfels.
Euphotide.
Diallage rock.
From Imponnetta, Tuscany.

369. Gabbro.
D. Euphotyde (Labrador et Diallage), (analysed by Delesse).
From Oderen, Dpt. du Haut Rhin.

370. Gabbro.
Diallage metalloïde.
Common Schiller-spar (Jameson).
From Radauthal, near Hartzburg.

371. Gabbro.
Diallage metalloïde.
Common Schiller-spar (Jameson).
From Radauthal, near Hartzburg.

372. Gabbro.
D. Diallage metalloïde.
Common Schiller-spar (Jameson).
From Radauthal, near Hartzburg.

373. Diallage (Gabbro).
Broncite (Bronzite).
Wurlitz, near Hof, in Bavaria.

374. Gabbro, Schillerfels.
D. Euphotide.
Diallage rock.
From Baumgarten, in Silesia.

375. Gabbro.
D. Diallage metalloïde.
Common Schiller-spar (Jameson).
From Radauthal, near Hartzburg.

376. Gabbro.
D. Diallage metalloïde.
Common Schiller-spar (Jameson).
From Radauthal, near Hartzburg.

377. Gabbro.
D. Diallage metalloïde.
Common Schiller-spar (Jameson).
From Radauthal, near Hartzburg.

378. Schillerfels.
Schillerspath mit Serpentin.
Schillerspar with Serpentine.
From the Baste, in the Hartz.

Red Numbers.	Name and Locality, &c.
379.	Schillerfels. Schillerspath mit Serpentin. Schillerspar with Serpentine. From the Baste, in the Hartz.
380. D.	Schillerfels. Schillerspath mit Serpentin. Schillerspar with Serpentine. From the Baste, in the Hartz.
381.	Edler Serpentin. Serpentine (Haüy). Noble Serpentine (Jameson). From Snarum, Norway.
382.	Edler Serpentin. Serpentine (Haüy). Noble Serpentine (Jameson). From Wurlitz, Bavaria.
383. D.	Serpentin. Ophiolite. Common Serpentine. From Imponnetta, Tuscany.
384.	Serpentin. Ophiolite. Common Serpentine. From Zöblitz, in Saxony.
385. D.	Serpentin, ophit. Ophiolite. Common Serpentine. From Zöblitz, in Saxony.
386. D.	Serpentin. Ophiolite. Common Serpentine. From Mitweida, Saxony.
387. D.	Serpentin. Ophiolite. Common Serpentine. From Waldheim, Saxony.
388. D.	Serpentin, ophit. Ophiolite. Common Serpentine (with pyrope garnet). From Zöblitz, in Saxony.
389. D.	Serpentin, ophit. Ophiolite. Common Serpentine (with decomposed pyrope garnet). From Zöblitz, in Saxony.

Red Numbers.	Name and Locality, &c.
390. D.	Serpentin mit pseudomorphem pyrop. Ophiolite grenatifère. Serpentine, with pseudomorphous pyrope. From Col du Pertuis, Dpt. des Vosges.
391. D.	Serpentin. Ophiolite. Common Serpentine, polaro-magnetic. From Magnetberg, near Darmstadt.
392. D.	Serpentin. Ophiolite. Common Serpentine. From Chamouny.
393. D.	Serpentin. Ophiolite. Common Serpentine (Serpentine opal). From Jordansmühle, Silesia.
394.	Serpentin. Ophiolite. Common Serpentine, with Steatite. From Sellenberg, near Hartzburg.
395.	Serpentin. Ophiolite. Common Serpentine, with chonikrite. From Porto Ferrajo, Elba.
396. D.	Serpentin, ophit. Ophiolite. Common Serpentine, with picrosmine. From Zöblitz, in Saxony.
397. D.	Serpentin. Ophiolite. Common Serpentine. From Gumberg, near Frankenstein, Silesia.
398. D.	Serpentin. Ophiolite. Common Serpentine (with magnetic iron). From Reichenstein, Silesia.
399. D.	Serpentin. Ophiolite. Common Serpentine, with asbestos and hyalite. From Jordansmühle, Silesia.
400. D.	Serpentin. Ophiolite. Common Serpentine (with kerolite). From Frankenstein, Silesia.

Red Numbers.	Name and Locality, &c.
401.	Serpentin. Ophiolite. Common Serpentine, with picrolite. From California.
402. D.	Asbestos and carbonate of lime out of Serpentine. From Jordansmühle, Silesia.
403. D.	Vein of chrysoprase in hornstone. From the Serpentine of Frankenstein, Silesia.
404. D.	Hornstone vein in Serpentine. From California.
405. D.	Magnesite forming veins in the Serpentine. From Frankenstein, Silesia.
406.	Ophicalce, Ophite. (Serpentin and granular limestone). From Ste Marie-aux-Mines, Vosges.
407.	Körniger kalk, marmor. Granular limestone, marble. Calcaire saccharoïde. From Carrara.
408. D.	Körniger kalk, marmor. Granular limestone, marble. Calcaire saccharoïde. From Carrara.
409. D.	Körniger kalk. Calcaire saccharoïde. Granular limestone, marble. From Campiglia, Tuscany.
410. D.	Körniger kalk. Calcaire saccharoïde. Granular limestone (vein of amphibole). From Campiglia, Tuscany.
411. D.	Körniger kalk. Calcaire saccharoïde. Granular limestone (iron pyrites). From Campiglia, Tuscany.
412. D.	Körniger kalk. Calcaire saccharoïde. Granular limestone. From the county of Comorn, Hungary.
413.	Körniger kalk. Calcaire saccharoïde. Granular limestone. From Krottendorf, in Saxony.

Red Numbers.	Name and Locality, &c.
414. D.	Körniger kalk. Calcaire saccharoïde. Granular limestone. From Auerbach, on the Bergstrasse (Hesse).
415. D.	Körniger kalk. Calcaire saccharoïde. Granular limestone. From Miltitz, Saxony.
416. D.	Körniger kalk, marmor. Calcaire saccharoïde; Bardiglio fior. Granular limestone, marble. From Serravezza, near Carrara.
417. D.	Körniger kalk, marmor. Calcaire saccharoïde, marmor maritimo. Granular limestone. Serravezza, near Carrara.
418. D.	Körniger kalk. Calcaire saccharoïde. Granular limestone, with chondrodite. From Baden, Saxony.
419. D.	Körniger kalk. Calcaire saccharoïde. Granular limestone (with couzeranite ?). From Campiglia, Tuscany.
420.	Körniger kalk. Calcaire saccharoïde. Granular limestone and granular gypsum, with mica. From Brenner, Tyrol.
421.	Körniger kalk. Calcaire saccharoïde. Granular limestone, with mica. From Oberbergen, in the Kaiserstuhl, Baden.
422. D.	Kalkglimmerschiefer. Calcareous mica schist. From Maxen, in the Erzgebirge.
423. D.	Kalkglimmerschiefer. Calcareous mica schist. From Zaunhaus, in the Erzgebirge.
424.	Dolomit des körnigen kalks. Dolomie. Dolomite of granular limestone. From Lengefeld, in Saxony.
425. D.	Dolomit des körnigen kalks. Dolomie. Dolomite of granular limestone. From Auerbach, Hesse.

Red Numbers.	Name and Locality, &c.

426. Dolomite des körnigen kalks.
D. Dolomie.
Dolomite of granular limestone, with crystals of Vesuvian, the interior of which is dolomite.
From Schwarzenberg, Saxony.

427. Dolomit des körnigen kalks.
D. Dolomie.
Dolomite from the granular limestone.
From Airolo, Switzerland.

428. Dolomit des körnigen kalks.
D. Dolomie.
Dolomite (with iron pyrites).
From Binden, Canton Valais.

429. Lava (volcanic bomb, thrown out at the eruption of May 1st, 1855).
From Vesuvius.

430. Lava (volcanic bomb, thrown out at the eruption of February, 1850).
From Vesuvius.

431. Lava (leucitic bomb, thrown out at the eruption of 1834).
From Vesuvius.

432. Lava, thrown out at the eruption of May 1st, 1855 (stamped while it was in a fluid state).
From Vesuvius.

433. Lava (with common rock salt, thrown out at the eruption of May 1st, 1855).
From Vesuvius.

434. Lava (with hornblende in needles, thrown out at the eruption of February, 1850).
From Vesuvius.

435. Lava of the year 1037.
Lave.
From Granatello, near Portici.

436. Lava ältere vom jahre 79 n. Chr.
Lave scorifiée ancienne.
Old lava (with muriate of copper), older than the year 79 A.D.
From Torre del Greco, on Vesuvius.

437. Augitophyre.
D. Lava, vorgeschichtliche.
Lava, præhistoric.
From Vesuvius.

438. Augitophyre.
D. Lava (thrown out at the eruption of February, 1850).
From Vesuvius.

Red Numbers.	Name and Locality, &c.

439. Lava, vorgeschichtliche.
Lava, præhistoric (with oxyde of iron).
From Vesuvius.

440. Lava (with olivine).
From Hafnefiord, Iceland.

441. Lava, porphyrytic.
From the mud volcanoes of Krisuvik, Iceland.

442. Lava.
From Roderberg, near Bonn.

443. Lava.
From Wassenach, near Laach (Bonn).

444. Lava.
From Wassenach, near Laach (Bonn).

445. Schlacke der basalt (augit) lava.
Slag of the basaltic (augitic) lava.
Scorie de la lava pyroxénique.
From Krunkskopf, on the Laacher See, Eifel.

446. D. Schlacke der basalt (augit) lava.
Slag of the basaltic (augitic) lava.
Scorie de la lava pyroxenique.
From Krunkskopf, on the Laacher See, Eifel.

447. Lava (porous augitic lava).
From the Laacher See, Eifel.

448. D. Lava (augitic micaceous lava).
From the Laacher See, Eifel.

449. Lava (augit lava).
From Bausenberg, Eifel.

450. D. Lava, partly decomposed.
From Bausenberg, Eifel.

451. Basalt (augit) lava.
Basaltic lava.
Lave pyroxénique.
From Glees, in the Eifel.

452. D. Lava (with quartz).
From Laacher See, Eifel.

453. D. Lava, verschlakter basalt (Leonhard).
Lava, slaggy basalt with Haüyne.
From Niedermendig, near Coblentz.

454. Lava, verschlakter basalt (Leonhard).
Lave.
Lava, slaggy basalt.
From Niedermendig, near Coblentz.

Red Numbers.	Name and Locality, &c.
455. D.	Lava. From Herchenberg, Eifel.
456. D.	Lava. From Hannebach, near Bonn, Eifel.
457.	Lava (compact). From Hannebach, Eifel.
458. D.	Lava (compact). From Difelderstein, Eifel.
459. D.	Lava, with melilite. From Herchenberg, Eifel.
460.	Leucitlava, leucitophyr. Lave à Amphigène (thrown out at the eruption of 1834). From Vesuvius.
461. D.	Leucitlava. Lave à Amphigène. Leucite lava. From Monte Somma (Vesuvius).
462. D.	Leucitlava. Lave à Amphigène. Leucite lava. From Monte Somma (Vesuvius).
463. D.	Leucitlava. Lave à Amphigène. Leucite lava. From Monte Somma (Vesuvius).
464.	Leucitlava (leucit porphyr). Lave à Amphigène. Leucite lava, porphyritic. From Monte Somma (Vesuvius).
465.	Leucitlava (leucit porphyr). Lave à Amphigène. Leucite lava, porphyritic. From Rieden, in the Eifel.
466. D.	Glimmer und augit lava. Lave micacée pyroxénique. Micaceous and augitic lava. From the Laacher See, Eifel.
467.	Glimmer und augit lava. Lave micacée pyroxénique. Micaceous and augitic lava, with rubellane. From the Laacher See, Eifel.
468. D.	Lava (pisolitic lava). From Rocca Monfina, Rome.
469. D.	Lava, Haüynofir. Hauynophyr. From Monte Vulture, Naples.

Red Numbers.	Name and Locality, &c.
470.	Lava, vorgeschichtliche. Lava, præhistoric (with gismondine). From Vesuvius.
471.	Lava, vorgeschichtliche. Lava, præhistoric, with Comptonite. From Vesuvius.
472.	Tuffartige lava. Piperino. Tufaceous lava. From Camandoli, near Naples.
473.	Lava, vorgeschichtliche. Lava, præhistoric (tufaceous, with augite) From Vesuvius.
474. D.	Trachytische bimsteinlava. Lave ponceuse trachytique. Pumiceous trachytic lava (Nosean rock). From the Laacher See.
475. D.	Trachytische bimsteinlava. Lave ponceuse trachytique. Pumiceous trachytic lava (Nosean rock). From the Laacher See.
476. D.	Trachytische feldspath lava. Lave ponceuse trachytique. Trachytic feldspathic lava. From the Laacher See.
477.	Trachytische feldspath lava. Lave ponceuse trachytique. Trachytic feldspathic lava. From the Laacher See.
478. D.	Trachytische Bimsteinlava. Lave ponceuse trachytique. Trachytic pumiceous lava, with Haüyne. From Laacher See.
479. D.	Vulkanische auswürflinge. Bombes volcaniques. Volcanic ejectamenta (garnet, hornblende, mica). From Vesuvius.
480. D.	Vulkanische auswürflinge. Bombes volcaniques. Volcanic ejectamenta (garnet and hornblende). From Vesuvius.
481. D.	Vulkanische auswürflinge. Bombes volcaniques. Volcanic ejectamenta (mica and anorthite). From Vesuvius.

Red Numbers. | Name and Locality, &c.

482. Lapilli, rapilli.
Cendres volcaniques.
Volcanic ashes.
From Vesuvius (eruption of 14th February, 1850).

483. Lapilli.
Rapilli.
Ash.
From Roderberg, near Bonn.

484. Vulkanische asche.
Cendres volcaniques.
Volcanic ashes.
From Roderberg, near Bonn.

485. Lapilli, rapilli.
Cendres volcaniques.
Volcanic ashes.
From Vesuvius (eruption of February 14th, 1850).

486. Lapilli, rapilli.
Cendres volcaniques.
Volcanic ashes.
From Vesuvius (eruption of February, 1849).

487. Vulkanischer sand.
Sable volcanique.
Volcanic sand.
From the Laacher See.

488. Puzzolana.
Vulkanischer tuff.
Volcanic tuff, Puzzolana.
From Pozzuoli, Naples.

489. Pausilipptuff.
Tuff du Pausilip.
Tuff of Pausilippo.
From Pausilippo, near Naples.

490. Peperino.
Vulkanischer tuff.
Volcanic tuff, peperino.
From Monte Somma, Vesuvius.

491. Trass.
Trassoite.
From Brohl, on the Rhine.

492. Vulkanischer tuff.
Tuff volcanique.
Volcanic tuff.
From Rieden, Eifel.

493. Vulkanisches conglomerat.
Conglomérat volcanique.
Volcanic conglomerate.
From Engeln, in the Eifel.

Red Numbers. | Name and Locality, &c.

494. Vulkanisches conglomerat.
Conglomérat volcanique.
Volcanic conglomerate.
From Engeln, in the Eifel.

495. Vulkanisches conglomerat.
Conglomérat volcanique.
From Brohl, on the Rhine.

496. Volcanic conglomerate.
From Baufuberg ? Eifel.

497. D. Volcanic conglomerate.
From Burgbröhl, Rhine.

498. D. Olivin.
Péridot granuliforme (Haüy).
Chrysolite (Phillips), (globules in volcanic tuff).
From Dreis, in the Eifel.

499. Bimstein conglomerat.
Conglomérat de ponce.
Pumice-stone conglomerate.
From Bendorf, near Coblentz.

500. Bimstein.
Lave vitreuse pumicée.
Glassy pumice (Jameson).
From Volcano (Lipari Islands).

501. Obsidian (Werner).
Volcanic glass.
Obsidienne.
From the Lipari Islands.

502. Obsidian (Werner).
Obsidian, porphyritic.
Obsidienne.
From Mount Krabla, Iceland.

503. D. Perlstein (Werner).
Lave vitreuse perlée.
Pearlstone.
From Hammersfiord, East Iceland.

504. Perlstein (Werner).
Lave vitreuse perlée.
Pearlstone.
From Glashütte, near Schemnitz, in Hungary.

505. D. Perlstein (Werner).
Lave vitreuse perlée.
Pearlstone.
From Monte Glosso, near Bassano, Euganean Hills.

506. Pechstein porphyr.
Pierre de poix porphyroïde.
Porphyritic pitchstone.
From Spechthausen, in Saxony.

Red Numbers.	Name and Locality, &c.

507. Pechstein.
D. Pierre de poix.
Pitchstone.
From Planitz, near Zwickau.

508. Pechstein.
Pierre de poix.
Pitchstone.
From Buschbad, near Meissen.

509. Pechstein.
D. Pierre de poix.
Pitchstone.
From Buschbad, near Meissen.

510. Palagonit conglomerat.
Palagonite conglomerate.
From Beselicher Kopf, near Limburg.

511. Palagonite conglomerate.
D. From Weyherr, in the Rhön Mountains.

512. Alaunstein, Alaunfels.
Alunite, roche alunifère.
Alum stone.
From Muzay, Hungary.

513. Alaunstein, Alaunfels.
D. Alunite, roche alunifère.
Alum stone.
From Muzay, Hungary.

514. Alaunstein.
Alunite.
Alum stone (alum rock).
From Castellina, in Tuscany.

515. Trachyt (Trachyt Bimstein).
Trachyte, a granular rock of glassy feldspar, albite, hornblende and mica (trachytic pumice stone).
From Monte Cuma, Naples.

516. Trachyt.
Trachyte.
From Ischia Island, Naples.

517. Trachyt.
Trachyte (porphyritic).
From Monte Santa Croce, volcano of Rocca Monfina.

518. Trachyt.
Trachyte (reddish compact).
From the mountain above Taraglioni, Ponza Island.

519. Trachyt.
Trachyte (taken from where the sulphur, &c., vapours come out).
From the Solfatara, Puzzuoli.

Red Numbers. Name and Locality, &c.

520. Trachyt.
Trachyte (porphyritic, with quartz).
From Geisberg, Siebengebirge, Bonn.

521. D. Trachyt.
Trachyte (porphyritic).
From Drachenfels, in the Siebengebirge.

522. D. Trachyt.
Trachyte.
From Perlenhardt Siebengebirge, near Bonn.

523. Trachyt.
Trachyte (trachyte granitoïde of Beudant).
From Drachenfels, in the Siebengebirge.

524. Trachyt.
Trachyte (porphyritic).
From the Siebengebirge, near Bonn.

525. Trachyt.
Trachyte (porphyritic, granitoid).
From the Siebengebirge, near Bonn.

526. D. Trachyt.
Trachyte.
From the Siebengebirge, near Bonn.

527. D. Trachyt.
Trachyte.
From Stenzelberg, in the Siebengebirge.

528. Trachyt (trachyte homogène, Burat).
Trachyte.
From the Wolkenburg, in the Siebengebirge.

529. D. Trachyt.
Trachyte (trachyte homogène, Burat).
From the Wolkenburg, in the Siebengebirge.

530. Trachyt.
From Margarethenkreutz (Siebengebirge).

531. D. Trachyt.
From Margarethenkreutz (Siebengebirge).

532. D. Trachyt.
From Margarethenkreutz (Siebengebirge).

533. D. Trachyt.
Trachyte.
From Rosenau, in the Siebengebirge.

534. D. Trachyt.
Trachyte.
From Rosenau, in the Siebengebirge.

535. D. Trachyt.
Trachyte.
From the Siebengebirge, near Bonn.

Red Numbers.	Name and Locality, &c.
536.	Trachyt. From Himmerich, near Honnef (Bonn).
537. D.	Trachyt. Trachyte. From the Kleiner Oeliberg, Siebengebirge.
538. D.	Trachyt. Trachyte. From the Petersberg, Siebengebirge.
539. D.	Trachyt. Trachyte. From the Petersberg, Siebengebirge.
540. D.	Trachyt. From the Vogelskau, in the Siebengebirge.
541.	Trachyt. From the Vogelskau, in the Siebengebirge.
542.	Trachyt. Trachyte. From Berkum, near Bonn.
543.	Trachyt. Trachyte (green). From Roettgen, Siebengebirge, near Bonn.
544. D.	Trachyt (ohne hornblende), (without hornblende). Trachyte (trachyte schistoide of Bendant). From Kühlsbrunnen, in the Siebengebirge.
545.	Trachyt (ohne hornblende). Trachyte (trachyte schistoide, semivitreux, Bendant). From Kühlsbrunnen, in the Siebengebirge.
546.	Trachyt. Trachyte. From Rosenau, in the Siebengebirge.
547. D.	Trachyt. Trachyte (with pseudomorphic hornblende). From the Siebengebirge, near Bonn.
548. D.	Hornblende. Amphibole (aus trachyt), (out of the trachyte). From Stenzelberg, in the Siebengebirge.
549.	Trachyt. Trachyte (earthy, with mica). From the Siebengebirge, near Bonn.
550. D.	Trachyt. Trachyte (earthy, with mica). From the Siebengebirge, near Bonn.
551. D.	Trachyt. Trachyte (earthy, with mica and quartz). From the Siebengebirge, near Bonn.

Red Numbers.	Name and Locality, &c.
552.	Trachyt conglomerat. Conglomérat trachytique. Trachytic conglomerate. From Königswinter, Siebengebirge.
553.	Trachyt conglomerat. Conglomérat trachytique. Trachytic conglomerate. From Langenberg, Siebengebirge.
554.	Trachyt conglomerat. Conglomérat trachytique. From Langenberg, Siebengebirge.
555.	Trachyttuff, Backofenstein. Tuff trachytique. Trachytic tuff. From Königswinter, in the Siebengebirge.
556.	Trachyttuff, Backofenstein. Tuff trachytique. Trachytic tuff. From Königswinter, in the Siebengebirge.
557.	Phonolith. Clinkstone. From Schlossberg, near Töplitz.
558.	Phonolith. Clinkstone. From Engelhaur, near Carlsbad.
559. D.	Phonolith. Clinkstone. From Grähberg, in the Högau.
560.	Phonolith. Clinkstone. From Ober Wiedershein, Wetterau.
561.	Phonolith. Clinkstone. From Saurenberg, in the Siebengebirge.
562. D.	Phonolith ; Klingstein. Phonolite. Clinkstone. From Quegstein, in the Siebengebirge.
563.	Phonolith. Clinkstone. From Olbrück, in the Eifel.
564.	Phonolith. Clinkstone. From Olbrück, in the Eifel.
565.	Phonolithtuff. Nosean rock, with small crystals of nosean. From Lehrberg, near Eugeln, in the Eifel.

Red Numbers. | Name and Locality, &c.

566. Phonolithtuff.
From Weyherr, in the Rhön Mountains.

567. Phonolith, Klingstone.
Phonolithe.
Clinkstone, with mesotype.
From Aussig, in Bohemia.

568. Analzimoplyr.
Analcime rock.
Potten, near Aussig, in Bohemia.

569. Trachydolerit (Abich).
Trachyte doleritique.
Doleritic trachyte.
From Brüngelsberg, in the Siebengebirge.

570. Dolerit (augit and Labrador).
Dolerite
From Meissner, in Hesse.

571. D. Dolerit.
From Kloster, Arensberg.

572. D. Dolerit.
From the Löwenberg, in the Siebengebirge.

573. Dolerit.
From the Löwenberg, in the Siebengebirge.

574. Nephelin Dolerit.
From Katzenbuckel, near Heidelberg.

575. D. Nephelinfels.
Nephelinite.
Nepheline rock.
From Löbau, in Saxony.

576. Dolerit (with hyalith).
From Frankfort.

577. D. Dolerit (porous).
From Eichen, in the Wetterau, near Frankfort.

578. D. Dolerit (with hyalith).
From Rudingen, near Hanau.

579. Osteolith (Bromeis in Lieb. u. Wochl. ann. 79).
Chaux phosphatée terreuse et compact.
Massive phosphate of lime (forming layers in the dolerit No. 577).
From Eichen, in the Wetterau.

580. Dolerit, Anamesit.
Dolerite.
From Steinheim, near Hanau.

581. Dolerit.
Dolerite.
From Bolvershahn, in the Siebengebirge.

Rod Numbers.	Name and Locality, &c.

582. Dolerit-conglomerat.
Conglomérat doleritique.
Doleritic conglomerate.
From the Löwenburger Tränke, in the Siebengebirge.

583. Basaltit.
Melaphyre compacte.
Compact melaphyre.
From Gottesberg, in Silesia.

584. Basaltit.
Melaphyre compacte.
Compact melaphyre.
From Gottesberg, in Silesia.

585. D. Dichter basalt.
Basalte compacte.
Compact basalt (with hyacinth).
From the Jungfernberg, in the Siebengebirge.

586. D. Dichter basalt.
Basalte compacte.
Compact basalt, with dendrites.
From the Jungfernberg, in the Siebengebirge.

587. Säulen-basalt.
Basalte prismatique.
Columnar basalt.
From Menderberg, near Linz, on the Rhine.

588. Basalt.
Basalte.
Basalt (porphyritic).
From Schemnitz, Hungary.

589. D. Basalt.
Basalt, porphyritic, including olivine and titaniferous iron.
From Unkel, on the Rhine.

590. D. Basalt.
Basalte.
Basalt (porphyritic, with pure augite particles).
From Kosakow, Bohemia.

591. D. Basalt.
Basalte.
Basalt (compact).
From the Teufelstein, in the Vogelsgebirge.

592. D. Basalt.
Basalte.
Basalt, with melaphyre and phonolite.
From Aussig, Bohemia.

593. D. Basalt.
Basalte.
Basalt, porphyritic, rich in olivine.
From the Groditzberg, Silesia.

Red Numbers. | Name and Locality, &c.

594. Körniger basalt.
Basalte granuleux.
Granular basalt.
From the Erpeler Leye, on the Rhine.

595. Basalt.
D. Basalte.
Basalt (passing into decomposition).
From Ober Cassel, near Bonn.

596. Basalt.
D. Basalte.
Basalt (with brown spar and calc spar).
From Ober Cassel, near Bonn.

597. Basalt.
D. Basalte.
Basalt (with sphœrosiderite and calc spar).
From Ober Cassel, near Bonn.

598. Hyalith, Glasopal (Hausmann).
D. Hyalite.
Hyalite (on basalt shale).
From Walsch, in Bohemia.

599. Hyalith, Glasopal (Hausmann).
D. Hyalite.
Hyalite (on porphyritic basalt).
From Walsch, in Bohemia.

600. Basalt (Mandelstein).
Basalte.
Basalt, amygdaloidal with arragonite.
From Alt Breisach, Upper Rhine.

601. Basalt (Mandelstein).
Basalte.
Basalt (amygdaloidal with mesotype).
From Hanau.

602. Basalt conglomerat.
D. Conglomérat basaltique.
Basaltic conglomerate.
From Owen, Wurtemberg.

603. Basalt conglomerat.
Conglomérat basaltique.
Basaltic conglomerate.
From the Siebengebirge (Rolandseck).

604. Basalt conglomerat.
Conglomérat basaltique.
Basaltic conglomerate.
From the Siebengebirge.

Red Numbers. Name and Locality, &c.

605. Basaltconglomerat.
D. Conglomérat basaltique.
Basaltic conglomerate.
From the Siebengebirge.

606. Basalt-wacke.
D. Wacke.
From Kassbach, near Linz, on the Rhine.

607. Basalttuff.
Tuf basaltique.
Basaltic tuff.
From the Wilhelmshöhe, near Cassel.

608. Basalttuff.
D. Tuf basaltique.
Basaltic tuff.
From the Wilhelmshöhe, near Cassel.

609. Amygdalophyr (Jenzsch).
D. From Weissig, near Dresden.

610. Amygdalophyr (Jenzsch).
From Weissig, near Dresden.

611. Eisenthon (Werner), with decomposed olivine.
D. From Limburg, in the Kaiserstuhl, Baden.

612. Eisenthon (Werner).
D. From Planitz, near Zwickau.

613. Wake.
Waké, vakite.
From Nidlar mine, near Barenstein, Saxony.

614. Wake.
D. Waké, vakite.
From Eisern, near Siegen.

615. Wake.
D. Waké.
From Menzenberg, near Bonn.

616. Basalt-Wacke.
D. Wacke.
From Ober-Cassel, near Bonn.

617. Basalt-wacke.
D. Wacke.
From Ober-Cassel, near Bonn.

618. Basalt-wacke.
Wacke.
From Ober-Cassel, near Bonn.

619. Basalt-wacke.
D. Wacke.
From Ober-Cassel, near Bonn.

Red Numbers. Name and Locality, &c.

620. Wake (with hornblende).
D. Waké, vakite.
From Weyherr, in the Rhön mountains.

621. Wake (mit. hornblende).
D. Waké, vakite.
From Weyherr, in the Rhön mountains.

622. Wake (with hornblende crystals).
D. Waké, vakite.
From Schima, in Bohemia.

623. Wake, with rubellane and Phillipsite.
D. Waké, vakite.
From Schima, in Bohemia.

624. Wake, columnar.
Waké, vakite.
From Gerolstein, Eifel.

625. Wake, columnar.
D. Waké, vakite.
From the Vogelsgebirge, Hesse-Darmstadt.

626. Wake (porous).
D. Waké, vakite.
From Ober-Cassel, near Bonn.

627. Wake (porous).
D. Waké, vakite.
From Ober-Cassel, near Bonn.

628. Wake (porous).
Waké, vakite.
From Ober-Cassel, near Bonn.

629. Wake, doleritic.
D. Waké, vakite.
From Darmstadt.

630. Wake, doleritic.
D. Waké, vakite.
From Darmstadt.

631. Mandelstein.
D. Pierre amygdaloïde.
Amydaloidal stone.
From Darmstadt.

632. Mandelstein.
D. Pierre amygdaloïde.
Amygdaloidal stone.
From Darmstadt.

633. Mandelstein.
D. Pierre amygdaloïde.
Amygdaloidal stone.
From Darmstadt.

Red Numbers. Name and Locality, &c.

634. Mandelstein.
D.
Amygdaloïde.
Amygdaloidal stone.
From Oberstein.

635. Mandelstein.
D.
Amygdaloïde.
Amygdaloidal stone, rich in green earth.
From Oberstein.

636. Mandelstein.
D.
Amygdaloïde.
Amygdaloidal stone.
From Oberstein.

637. Mandelstein.
D.
Pierre amygdaloïde.
Amygdaloidal stone.
From Landeshut, Silesia.

638. Mandelstein.
Pierre amygdaloïde.
Toadstone.
From Planitz, Saxony.

639. Mandelstein.
D.
Pierre amygdaloïde.
Toadstone, with steatite.
From Ilmenau.

640. Mandelstein.
D.
Pierre amygdaloïde.
Toadstone.
From Ilmenau, Thuringia.

641. Mandelstein.
Pierre amygdaloïde.
Toadstone, with chabasite and analcime.
From the Seisser Alp, South Tyrol.

642. Mandelstein.
Pierre amygdaloïde.
Toadstone, with apophyllite.
From the Seisser Alp, South Tyrol.

643. Mandelstein.
D.
Pierre amygdaloïde.
Toadstone, with analcime and chabasite.
From Montechio Maggiore, near Vicenza.

644. Mandelstein.
D.
Pierre amygdaloïde.
Toadstone (with arragonite and Faujassite).
From Kaiserstuhl, in Baden.

Red Numbers.	Name and Locality, &c.

645. Mandelstein.
D.
Pierre amygdaloïde.
Toadstone (with arragonite and hyalite).
From Kaiserstuhl, in Baden.

646. Mandelstein.
D.
Pierre amygdaloïde.
Toadstone (with calcspar).
From Ilfeld, Hartz.

647. Mandelstein.
D.
Pierre amygdaloïde.
Toadstone (with calcspar and amethyst).
From Ilfeld, Hartz.

648. Achat.
Agate (out of the amygdaloidal stone).
From Walkenried, in the Hartz.

649. Amethyst and chalcedony.
Quartz hyalin violet.
Amethyst and chalcedony (from the amygdaloidal stone).
From Oberstein.

650. Achat (Werner) and quartz.
Agate and quartz nodule, from the amygdaloidal stone).
From Oberstein.

651. Achat (Werner).
Agate (from the amygdaloidal stone).
From Oberstein.

652. Achat (Werner).
Agate (from the amygdaloidal stone).
From Oberstein.

653. Achat.
Agate (out of the toadstone).
From San Leopoldo, Buenos Ayres.

654. Polierschiefer (Werner).
D.
Schiste tripoléen (Haüy).
Polishing-slate (pseudo volcanic, altered by earth fire, *i.e.*, burning coal beds).
From Kutschlin, near Bilin, Bohemia.

655. Polierschiefer (Werner).
Schiste tripoléen (Haüy.
Polishing-slate (pseudo volcanic, formed by burning brown coal beds).
From Habichtswald, near Cassel.

656. Halbopal.
D.
Semi opal, pseudo volcanic, plastic clay altered by earth fire.
From Bilin, Bohemia.

Red Numbers. Name and Locality, &c.

657. Halbopal.
Semi opal, pseudo volcanic, infusorial earth, altered by earth fire.
From Tokay, Hungary.

658. Porzellanjaspis.
D. Durch erdbrände veränderter plastischer Thon.
Pseudo volcanic, plastic clay altered by subterranean fire.
From Töplitz, Bohemia.

659. Thoneisenstein.
D. Fer oxydé argilifère.
Clay ironstone, pisiform, pseudo volcanic.
From Töplitz, Bohemia.

660. Stänglicher thoneisenstein (Werner).
Fer oxydé rouge bacillaire (Haüy).
Columnar clay ironstone (pseudo volcanic).
From Töplitz, Bohemia.

661. Altered coal shale, pseudo volcanic.
From Frankerode, Saxony.

662. Plastic clay from the older coal measures, altered into porcelain jasper (pseudo volcanic).
D. From Planitz, Saxony.

663. Plastic clay from coal measures, altered by earth fire.
From Planitz, Saxony.

664. Eisensteinmark (Freiesleben), teratolit.
D. Ferruginous lithomarge rock (pseudo volcanic).
From Planitz, near Zwickau.

665. Granite vein, running through Gneiss.
From Schneeberg, Saxony.

666. Granite vein, running through clay slate.
D. From Schneeberg, Saxony.

The following rock specimens were presented to the Geological Survey of Ireland by Dr. H. B. Geinitz, of Dresden, with a collection of fossils from the Planerkalk and other formations of Germany. They are marked in red numbers, with a G before them, and placed in one of the table drawers.

Red Numbers.	Name and Locality, &c.
G. 1.	Pechstein, aus dem Triebisch thal bei Meissen. Pitchstone, from the Triebs Valley, near Meissen (Saxony).
G. 2.	Pechstein, aus dem Triebisch thal bei Meissen. Pitchstone, from the Triebs Valley, near Meissen (Saxony).
G. 3.	Pechstein, aus dem Triebisch thal bei Meissen. Pitchstone, from the Triebs Valley, near Meissen (Saxony).
G. 4.	Pechstein von Korbitz, bei Meissen. Pitchstone, from Korbitz, near Meissen.
G. 5.	Pechstein porphyr mit Einschlüssen des Tharander porphyrs, von Spechtshausen bei Tharand. Pitchstone porphyry, with enclosed pieces of the Tharand porphyry from Spechtshausen, near Tharand, in Saxony.
G. 6.	Basaltit: aelterer melaphyr vom alter des unteren Rothliegenden von Kainsdorf bei Zwickau. Basaltite: older melaphyr of the age of the Lower Rothliegende (base of the Permian formation), from Kainsdorf, near Zwickau.
G. 7.	Basaltit, mandelstein: grüner mandelstein, vom alter des untern Rothliegenden, von Kainsdorf bei Zwickau. Basaltite amygdaloid, green amygdaloid, of the age of the Lower Rothliegende, from Kainsdorf, near Zwickau.
G. 8.	Basalt, mandelstein: grüner mandelstein, vom alter des untern Rothliegenden, von Kainsdorf bei Zwickau. Basaltite amygdaloid, green amygdaloid, of the age of the Lower Rothliegende, from Kainsdorf, near Zwickau.
G. 9.	Felsit porphyr, von Dornreichenbach, bei Leipzig. Felstone porphyry, from Dornreichenbach, near Leipsic.
G. 10.	Potschappeler porphyr, bei Dresden, aelter als die Steinkohlen formation des Plauenschen Grundes. Potschappel porphyry, near Dresden, older than the Carboniferous formation of the Plauenschen Grund.
G. 11.	Sogenannter blauer Wilsdruffer porphyr, von Kesselsdorf, bei Dresden. So called blue "Wilsdruffer" porphyry, from Kesselsdorf, near Dresden.
G. 12.	Tharander porphyr, aus dem oberen Rothliegenden vom Windberge, von Plauenschen Grunde, bei Dresden. Tharand porphyry, from the upper Rothliegende (the lower part of the Permian rocks), from Windberg, in the Plauenschen Grund, near Dresden.

Red Numbers.	Name and Locality, &c.
G. 13.	Dresdener Pflasterstein, Syenit, aus dem Plauenschen Grunde, bei Dresden. Dresden paving-stone, syenite. From the Plauenschen Grund, near Dresden.
G. 14.	Syenit, von Bernsdorf, bei Dresden, rechte Elbufer. Syenite, from Bernsdorf, near Dresden (right bank of the Elbe).
G. 15.	Granit porphyr, v. Mühlberg, Sachsen. Granite porphyry (or porphyritic granite), from Mühlberg, Saxony.
G. 16.	Granit porphyr, v. Kahleberg, Sachsen. Granite porphyry (or porphyritic granite), from Kahleberg, Saxony.

Attention should also be directed to the following large rock masses, which are not arranged in order, but placed where most convenient about the Gallery.

A. Part of a stalactitic column, from the Mitchelstown Caves.
Presented by Mr. Rae, on the part of the Tipperary Agricultural Company.

[Near the central fireplace.]

B. Block of jasper (? from the drift), from Co. Wexford.
Presented by the Right Hon. the Earl of Courtown.

[Near the central fireplace.]

C. Block of Rocksalt, from the saltmine of Duncrae, near Carrickfergus.
Presented by the Most Hon. the Marquis of Downshire.

[Opposite the foot of the stairs.]

D. Two masses of coal, forming sections of two seams from the roof to the floor, from collieries near Castlecomer.
Presented by the late Hon. Mr. Wandesforde.

[One on each side of the block of Rock salt.]

E. Blocks of anthracite, one with a polished surface, from Llanelly, S. Wales.
Presented by Messrs. Morgan & Sons, Llanelly.

[Against the southern wall.]

F. Basaltic columns, from Co. Antrim.
Purchased from Mr. Doran.

[Against the northern wall, near the fireplace.]

G. A lion, an architectural ornament, and slabs like Obsidian, cast from the basalt of the Rowley Hills, near Dudley.
From Messrs. Chance's Chemical Works, Oldbury, near Birmingham.

H. Granite vein, with the walls of mica schist adhering to it, from a quarry at Ballybrack, near Kingstown, Dublin.

Presented by Mr. O'Kelly, of Rochestown House.

[Under the stairs, on the N. side.]

I. A large irregular slab or block of a recent formation at the bottom of the Irish Sea.

Presented by Mr. J. Good, whose account of it is annexed.

"This piece of rock was taken up by a trawl, about twenty miles S.W. of the Calf-of-Man, from a depth of forty fathoms. The substance is known to fishermen as 'cement,' and the locality is called the 'bring ups,' on account of the nets getting so often hitched into it and bringing up pieces of it from the bottom. There is a patch or strip of this material, running forty miles in length, by about seven miles wide, lying in a N.N.E. and S.S.W. direction, commencing fifteen miles S.W. of the Calf-of-Man."

The substance seems to be a gray sand cemented by carbonate of lime, with many embedded bivalve shells, and numerous cases of serpula, the whole forming a firm conglomerate of shells and annelids in the sand. It seems to occur in ledges at the bottom, probably in consequence of the partial consolidation of the sand and the removal of the unconsolidated portion by currents at the bottom.

Mr. Good says, that to the S.E. of the "cement" bank there is another bank of smooth red sand, about twelve miles long and five wide, tapering to a point each way, with from thirty-five to thirty-eight fathoms of water on it, but much deeper water, with a rough bottom, on each side of it.

[Under the stairs, on the S. side.]

J. A square block and a polished slab of white marble, from Dunlewy, Co. Donegal.

[Under the stairs, near the door of the Physical Preparation room.]

J. B. J.

DUBLIN: Printed by ALEXANDER THOM, 87 & 88, Abbey-street,
For Her Majesty's Stationery Office.

No. 3.

Science and Art Department

OF THE

COMMITTEE OF COUNCIL ON EDUCATION,

INDUSTRIAL MUSEUM OF IRELAND.

INVENTORY CATALOGUE

OF THE

SPECIMENS ILLUSTRATING THE NATURE, EXTENT, AND USES

OF THE

IRISH, BRITISH, AND FOREIGN COAL AND PEAT FUEL DEPOSITS,

AND THE

MATERIALS, PROCESSES, AND PRODUCTS

OF THE

IRON AND STEEL MANUFACTURES,

IN THE

COLLECTION

OF THE

INDUSTRIAL MUSEUM OF IRELAND.

DUBLIN:
PRINTED BY ALEXANDER THOM, 87 & 88, ABBEY-STREET,
FOR HER MAJESTY'S STATIONERY OFFICE.

1866.

NOTICE.

Explanation of the Numbers upon the Specimens.

Each Specimen is marked with a red and a black number.

The red numbers run in consecutive order, and serve to indicate the Specimens contained in each case.

The black numbers are consecutive for each series of Specimens, whether in the same case or not.

CONTENTS.

LOWER NORTH GALLERY.

WALL-CASE A.

Containing: specimens of English and Scotch coals; series of rocks, specimens illustrative of the Geological structure of the Coal Measures; iron ores, raw and calcined; pig-iron, high furnace and refining furnace cinder; specimens illustrative of the manufacture of British Bar Iron; series of Belgian iron ores, coals, &c., used at Seraing in Belgium, and of the pig, wrought iron, and steel made therefrom; series of the more important iron ores of Sweden; and specimens of New Zealand coal.

Red Numbers on Specimen.*	Black Numbers on Specimen.	
		COALS, IRON STONES, FIRE-CLAYS, PIG-IRON, OF ENGLAND AND WALES.
		HÆMATITES, &c., NOT BELONGING TO SPECIFIC SERIES.
1–4	1	Brown Hæmatite, Cornwall.
5, 6	2	Brown iron ore, *Limonite*, from Hengistbury Head, Hampshire Coast. (Middle Eocene.)
		IRON ORES FROM OOLITIC LOCALITIES.
7, 8	1	Iron ore, Blisworth.
9, 10	2	ditto calcined.
11, 12	3	Clay iron stone, Grosmont Whitby.
13	4	ditto calcined.
14, 15	5	Clay iron stone, Normanby Mines. Cleveland, Yorkshire.
16, 17	6	ditto calcined.
		COALS AND IRON ORES FROM THE FOLLOWING ENGLISH LOCALITIES :
		1. BRISTOL COAL FIELD; 2. SOUTH WALES; 3. STAFFORDSHIRE; 4. SHROPSHIRE; 5. NORTH STAFFORDSHIRE; 6. NORTH WALES; 7. LANCASHIRE; 8. CUMBERLAND; 9. DERBYSHIRE, NOTTINGHAM, AND YORKSHIRE; 10. NORTHUMBERLAND; 11. DURHAM.

* See Explanation, p. 2.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		SPECIMENS OF THE COALS FROM GLOUCESTERSHIRE.
		(Bristol Coal Field)
18	1	Large vein coal, Stapleton.
19, 20	2	Small vein coal, ditto.
		Presented by J. C. Hawley, Esq.
		SPECIMENS OF THE COALS AND IRON ORES OF SOUTH WALES.
21	1	Coal from Moreton, Pembrokeshire.
22, 23	2	Coke from ditto.
24–26	3	Coal from Swansea.
27	4	Coke from ditto.
28, 29	5	"Jussoles" coal, Cardiff.
30	6	Coke from ditto.
31–33	7	Iron stone from Flampora.
34	8	Iron stone from Trinsarren, Pembre, Carmarthen.
	9	N.B.—At the end of the Lower South Gallery will be found two large specimens of Anthracite, from Llanelly, Carmarthenshire. *Presented by Messrs. Morgan and Sons, Llanelly.*
		SPECIMENS ILLUSTRATIVE OF THE COALS, IRON ORES, FIRE-CLAYS, AND OF THE MANUFACTURE OF IRON IN SOUTH STAFFORDSHIRE.
		Presented by Mr. Thomas Barker, Chillington Iron Works, Wolverhampton.
		Coals.
35	1	Brooch coal, Dudley.
36	2	Sulphur coal, ditto.
37	3	Flying red coal, ditto.
38	,,	Fire-clay associated with "flying red" coal.
39	4	New mine coal, Dudley.
40	,,	Fire-clay associated with New mine coal.
41	5	Fire-clay coal.
42	,,	ditto coke.
43	6	Thick coal measure between 30 and 40 feet thick.
44	7	Heaten coal.
45	8	Bottom coal, Dudley.
46	,,	Fire-clay associated with Bottom coal.
		Iron Stones.
47	1	"Diamonds" iron stone.
48, 49	,,	ditto ditto calcined.
50, 51	2	"Poor Robin's" iron stone, Wolverhampton.
52	,,	ditto ditto calcined.

Red Numbers on Specimen.	Black Numbers on Specimen.	
53	3	"Blue flats" iron stone.
54, 55	"	ditto calcined.
56	4	Balls iron stone.
57		ditto calcined.
58	5	"Gubbin" iron stone.
59	"	ditto calcined.
60, 61	6	White iron stone, Dudley.
62	"	ditto calcined.
		Pig Irons.
63, 64	1	Mottled pig iron. *Strong for forge purposes.*
65–67	2	White pig iron, brittle. *Good for bell metals.*
68, 69	3	Grey pig iron, very strong, *for castings.*
70–72	4	Refined pig iron, moderately strong.
73	5	Strong forge iron.
74	6	Slags from Puddling furnace, remelted in Blast furnace (*Tap Cinder*).
75–77	7	Slag from remelting furnace, also remelted.
		Irons.
78, 79	1	Puddled bars, the first stage after puddling.
80–104	2	Merchant, or rolled iron.
105–6	3	Hoop iron.
107	4	Specimen of boiler plate.
108	5	Book of sheet iron rolled from one piece.
109	6	Specimens of T rails, principally used on American lines.
110	7	Double headed, or H rail (London and North-Western section).
111	8	Bridge, or hollow rail (Great Western section).
112	9	Break joint rail (an American patent).
		SPECIMENS ILLUSTRATIVE OF THE IRON MADE IN SHROPSHIRE.
		From the Coal Brook Dale Company, Lane End Iron Works, Shropshire.
113–16	1,2,3,4	Samples of grey pig iron.
117–18	5	White pig iron.
		SPECIMENS ILLUSTRATIVE OF THE COAL AND IRON STONES OF NORTH STAFFORDSHIRE.
		Presented by Arthur Sparrow, Esq.
		Coals.
119	1	Bowling-alley coal, Bentley Colliery.
120	2	Cockshead or Cockshute coal, Bentley Colliery near Longton.

Red Numbers on Specimen.	Black Numbers on Specimen.	
121	3	"Great row" coal, Foley Colliery, Longton.
122	4	"Moss" coal, ditto.
123	5	"Ash" coal, ditto.
124	6	Sparrow-But mine coal, ditto.
125	7	Cockshead mine coal, ditto.
126	8	Holly-lane coal, ditto.
127	9	Hanbury mine coal, ditto.
128	10	Ten-foot mine coal, ditto.
129	11	Bowling-alley coal, ditto.
130	12	Little mine coal.
		Iron Stones.
131–32	1	*Knowle's* Iron stone, Foley Colliery, Longton.
133	2	*Chalky mine* Iron stone, ditto.
134–35	3	*New mine* Iron stone, ditto.
136	"	*Ditto* calcined, ditto.
137	4	*Bassy mine* Iron stone, ditto.
138		*Ditto* calcined, ditto.
139	5	Black band Iron stone, ditto.
140–41	6	*Deep mine* Iron stone, ditto.
142–44	7	Hanbury mine Iron stone, ditto.
145–47	8	Clay Iron stone, ditto.
		SPECIMENS OF THE COALS, IRON ORES, &c., OF NORTH WALES.
		Flintshire, Denbighshire, &c.
148	1	Moystin coal, *N.W.*
149	2	Limestone used as "flux."
150–52	3	Clay iron stone nodules.
153	4	Iron coal with seam of cannel coal, Denbighshire.
		COALS OF LANCASHIRE.
154	1	Cannel coal, Wigan.
155	2	Orrell coal, ditto.
		SPECIMENS OF THE COALS AND IRON ORES OF CUMBERLAND.
		Coals.
156–57	1	Blenkinsop coal, Cumberland.
158–60	"	ditto coke, ditto.
161	2	Workington coal, ditto.

Red Numbers on Specimen.	Black Numbers on Specimen.		No.	p.
		Iron Ores.		
162–64	1, 2, 3	Red hæmatite, from Whitehaven.		
		SERIES OF SPECIMENS OF THE IRON ORES OF DERBYSHIRE.		
		Presented by Warington W. Smyth, M.A., F.R.S. &c.		
		These specimens are from the collection formed by S. H. Blackwell, esq., for the Great Exhibition of 1851, and are described in the "Memoirs of the Geological Survey: Iron Ores of Great Britain. Part I." The numbers 345 to 402 affixed to the specimens, refer to the number of the specimens and the page of that Memoir.		
		The numbers affixed to the specimens refer also to Mr. Blackwell's Catalogue, which is given in the Illustrated Catalogue of the Great Exhibition, vol. I., p. 156.		
165	1	Top measure, of the *Brown rake,* at Butterley, ...	345	37
166	2	Bottom measure, of the *Black rake,* at Butterley, ...	348	37
167	3	Marble measure, of the *Dog-tooth rake,* at Staveley, ...	354	38
168	4	Balls from *Dog-tooth rake,* at Staveley, .	355	„
169	5	Brown measures, from Clay Cross, .	357	„
170	6	Cinder measures, from the *Nodule rake,* Morley Park, ...	358	„
171	7	Balls, from the *Nodule rake,* Morley Park,	359	„
172	8	Three-quarter balls, do. do. .	360	„
173	9	Whetstone, of the *Blackshale rake,* near Chesterfield, ...	361	„
174	10	Lower blues, — From *Blackshale rake,* near Chesterfield.	365	„
175	11	Old man,	366*a*	„
176	12	Old woman,	366*b*	„
177	13	Red measure,	370	„
178	14	Dun,	371*a*	„
179	15	Roof measure,	372	„
180	16	Iron stone, from the *Striped rake,* Kirkhallam, near Chesterfield, . .	375	„
181	17	Balls and bottom measure, from the Greenclose rake, Morley Park, . .	377	„
182	18	Iron stone, from the *Hollyclose rake,* Morley Park, ...	374	„
183	19	Iron stone, from the *Black or Ketland's rake,* Morley Park, from 379 to	384	„
184	20	Iron stone, from the *Baconflitch rake,* Alfreton, ...	385	39
185	21	Iron stone, from the *Yew-tree rake,* Morley Park, ...	386	„

Red Numbers on Specimen.	Black Numbers on Specimen.		No.	p.
186	22	Chitters, From the Honeycroft rake, Stanton.	387	39
187	23	Tufty balls, From the Honeycroft rake, Stanton.	388	,,
188	24	Grinder's Wife, From the Honeycroft rake, Stanton.	391	,,
189	25	Big balls, From the Honeycroft rake, Stanton.	392	,,
190	26	Ratchell measure, *Civilly rake*, Stanton,	395	,,
191	27	Chitters, ditto,	398	,,
192	28	Roof measure, *Dalemoor rake*, do.,	402	,,

Nottingham and Yorkshire.

ILLUSTRATIVE SERIES OF THE COAL, IRON ORES, AND OF THE IRON MADE THEREFROM, AT THE LOW MOOR WORKS, NEAR BRADFORD, YORKSHIRE.

Presented by W. Fenton, Esq., Manager.

193-94 | 1 | Best coal of the soft kind.

195-96 | 2 | Ditto hard.

These specimens of coal lie from sixty to 100 yards below the surface, and are from twenty-four to twenty-six inches in thickness in the bed.

197 | 3 | Coke made from the above.

This is prepared by burning the coal in ovens or in rows on the ground, to purify it from sulphur and other matter which would be injurious to the Iron; it is used in the blast or smelting furnaces.

198 | 4 | Black bed coal.

This coal lies from forty to forty-two yards above the Best or Better Bed Coal, and the bed is from thirty-four to thirty-six inches in thickness; used for steam engine boilers and house fire.

199 | 5 | Coke made from the above.

Used for limekilns, stoves for drying cores, for moulding castings, and other common purposes.

200 | 6 | Black Iron stone.

This lies immediately above the Black Bed Coal, is found in six distinct strata, and forms a bed of five feet in thickness; the whole being embedded in shale, containing twenty-eight per cent., or seventy-three cwt. to produce one ton of metal.

Red Numbers on Specimen.	Black Numbers on Specimen.	
201	7	White Iron stone. This lies twenty-two yards above the Black Bed Coal, and is found in seven strata, which compass seven feet, and is embedded in shale, containing twenty-eight per cent. metal, but is not so highly esteemed as the Black stone.
202	8	Burnt Iron stone. Prepared by roasting or burning in kilns or in heaps on the ground, to separate all injurious matter; it is then taken to the blast furnaces to be smelted.
203	9	Limestone. This is brought from Skipton, and is used in the furnaces as flux for the Iron stone; requires twenty-two cwt. for one ton of iron.
204	10	Pig Iron, best quality, or No. 1. Used for small or intricate castings, being the softest metal.
205	11	Pig Iron, second quality, or No. 2. Used for weighty castings, where strength is required.
206	12	Pig Iron, third quality, No. 3. Used for making Bar Iron and other forge purposes, and for large castings.
207	13	Scoria or Dross. Is composed of the argillaceous or earthy part of the Iron stone, combined with Limestone, for which it has a strong affinity, and is used for making roads.
208	14	Refined Iron. Prepared from No. 3 Pig Iron, by being exposed, in small low furnaces, to a powerful blast. These furnaces are called refiners, and the metal when run into moulds is in the second state of manufacture.
209	15	Dross from the refinery. Is the impure matter which runs from the refinery with the metal, but being lighter flows on the surface; it contains from forty to fifty per cent. iron, which may be extracted in the smelting furnaces by the addition of argillaceous matter.
210	16	Puddled Iron. Is Iron in the next stage after refined metal, being in a semi-malleable state. After having been stirred in a furnace till it acquires a welding property, it is taken out and flattened under heavy hammers.

Red Numbers on Specimen.	Black Numbers on Specimen.	
211–14	17	Dross from puddling furnace.
215–18	18	Finished Bar and Rod iron.
219	19	Boiler plate.
220–23	20	Knots tied cold.
224–40	21	Sundry specimens tested by hydraulic pressure in a cold state.
		Specimens of the Raw Materials used in the Manufacture of Iron at the Walker Iron Works, near Newcastle-upon-Tyne, and of the Pig and Puddled Iron made, as illustrations of the Coal and Iron Districts of Northumberland and Durham. *Presented by Messrs. Wilson, Losh, and Bell, Walker Iron Works, Newcastle-upon-Tyne.*
241	1	Newcastle coal.
242	"	Ditto coke.
243	2	Newcastle coal, Washington.
244–46	"	Ditto coke, ditto.
247	3	Coal used for coking, Walker's Colliery, Northumberland.
248	"	Coke from ditto.
249	4	Grey splint coal section, Belaval Northumberland.
250	5	Clay iron stone band, Hedley Colliery, Northumberland.
251	"	Ditto calcined.
252	6	Scoriæ from heating furnace.
253	7	Slag or cinder from high furnace.
254	8	Foundry pig iron.
255	9	White forge pig iron.
256	10	Puddled iron as it comes from the puddling furnace.
257–58	11	Puddled iron for merchant bars.
259	12	Puddled iron from Stirling's refined metal for rails.
260	13	Stirling's pig metal, refined by oxide of iron.
261	14	Mixture of sawdust and "Black band" used as a lining for pig iron moulds in refining pig iron according to Stirling's process.
262	15	Durham coke, used for cupola smelting.
263	16	Puddled iron from Stirling's refined metal for rails.
264	17	Puddled iron for merchant bars.
265	18	Bar of iron fractured to show resistance to strain.

Red Numbers on Specimen.	Black Numbers on Specimen.	
266	19	Thirty-five specimens of rails, T angles, and angle irons, &c.
267	20	Two iron plates.
268	21	Double T rail bolted together.
		SERIES OF SPECIMENS ILLUSTRATIVE OF THE PROCESS OF WASHING SMALL COAL BY MEANS OF BERARD'S MACHINE. *Presented by J. Morisson, Esq.*, 16, *Sandhill, Newcastle-upon-Tyne.* (*The English patentee and improver of Berard's Machine.*)
269	1	Sample of small coal as it comes at the pit mouth, containing fragments of iron pyrites, shales, and other impurities.
270	2	Sample of pyrites, shale, and foreign matters washed out of the coal, No. 1.
271	3	Sample of pure or washed coal from which the pyrites and shale have been recovered.
272	4	Coke made from unwashed coal.
273–74	5	Coke made from the washed coal, No. 3.
275–76	6	Coke from coal, prepared by Berard's machine.
		COALS, IRON STONES, FIRE-CLAYS, &C., OF SCOTLAND.
		SPECIMENS OF IRON ORES FROM FIFESHIRE.
277–78	1, 2	Black band iron stone, Mount Melville Mines, St. Andrews.
279–81	,,	Ditto calcined.
		SERIES OF SPECIMENS OF SANDSTONES, LIMESTONES, SHALES, IRON STONES, AND COALS, ILLUSTRATIVE OF THE GEOLOGICAL STRUCTURE OF THE LANARKSHIRE COAL FIELD. SERIES OF SPECIMENS ILLUSTRATIVE OF THE MANUFACTURE OF PIG IRON, AND THE PROCESS OF PUDDLING, AND OF THE VARIOUS WROUGHT IRON PRODUCTS (RAILS, ANGLE IRON, &C.), MADE AT THE MONKLAND IRON WORKS, LANARKSHIRE. *Exhibited at the Dublin Exhibition in* 1853, *and afterwards presented to the Museum by Mr. W. Murray, Manager of the Monkland Works.*
282–84	1–9	Large blocks of sandstones and freestones.
285	10	Ditto of sandstone, with *fucoid-like* impressions.
286-300	11–25	Large blocks of clay iron stone, and iron stone bands.
301–7	26–32	Specimens of Coal.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		Illustrative Collection.
308	1	Raw black band.
309–10	„	Ditto calcined.
311–12	2	Raw black band, "calder braes."
313–15	„	Ditto calcined.
316	3	Raw soft band, "calder braes."
317	„	Ditto calcined.
318	4	Raw clay band,
319	„	Ditto calcined.
320	5	Limestone used as "flux."
321–24	6	Cinder of pig iron.
325	7	Calcined cinder, technically called "Bull dog."
326	8	Cinder of white iron.
327–30	9	Grey pig iron.
331–33	10	White pig iron.
334–35	11	Refined iron, blown.
336	12	Refined iron, overblown.
337–39	13	Puddled bars.
340–45	14	Mill bars.
346–47	15	Refined iron, nearly made before being squeezed or pressed.
348	16	Specimens of iron in welding process.
349	17	Iron after hammering.
350–58	18	Specimens of rails, T rails, angles, &c.
359	19	Soft coal } used at Monkland iron works.
360–61	20	Splint coal } used at Monkland iron works.
		N.B.—At the end of the Lower North Gallery will be found a section representing the stratigraphical succession of the Carboniferous formation in Lanarkshire, likewise presented by Mr. Murray.
		IRON ORES, COAL, &c., OF BELGIUM.
		SERIES OF SPECIMENS OF IRON ORES FROM THE VALLEYS OF THE SAMBRE, MEUSE, AND OURTHE, AND OF COAL, COKE, AND LIMESTONE USED IN MAKING IRON AT THE GREAT IRON WORKS OF SERAING, NEAR LIÈGE; AND OF THE CINDER, PIG, AND PUDDLED IRON, AND CAST-STEEL PRODUCED THEREFROM.
362	1	Red oolitic hæmatite (called, locally, "*mine rouge*"), from Revin.
363–64	2	Brown hæmatite, hydrate of oxide of iron (called, locally, "*mine jaune*"), Angleur, near Liège.
365	3	Ditto, calcined.
366–67	4	Brown hæmatite, Graux, S.W. of Namur (Sambre and Meuse).

Red Numbers on Specimen.	Black Numbers on Specimen.	
368	5	Brown hæmatite, St. Maur, Meuse.
369–70	6	Brown hæmatite, Werbomont (Ourthe).
371	7	Pisolitic hæmatite, Louveignez.
372	8	Brown pisolitic hæmatite, Mellotte.
373	9	Brown pisolitic hæmatite, Malonne, near Namur.
374	10	Brown hæmatite, La Reid.
375–77	11	Clay iron stone, called, locally, "schiste houiller," Mons and Charleroi.
378	12	Ditto, calcined.
379–80	13	Brown hæmatite, Missoul.
381–82	14	Limestone used as flux.
383–84	15, 16	Cinder slag.
385–86	17, 18	Scoriæ cinders.
387	19, 20	White cast iron.
388	21	Superior cast iron.
389–95	22	Specimens of puddled iron.
396-402	23	Various specimens of cast steel.
403	24	Coal employed at Seraing, near Liège.
404	25	Coke, ditto.
		IRON ORES OF SWEDEN.
		COLLECTION OF IRON ORES. *Presented by Professor Andreas Grill, of Stockholm, Sweden.*
405	1	Average specimen of magnetic iron from the mine of Silfberg, Dannemora, County of Upsala.
406	2	Specimen of magnetic iron ore from the mine of Herrgrufve, Dalkarlsberg, County of Orebro.
407	3	Specimen of specular iron ore from the mine of Langgrufve, Dalkarlsberg, County of Orebro.
		Nearly all the iron of this ore is specular iron.
408	4	Specular iron ore from Asboberg, Nora District; one of the best ores in the world.
409	5	Specular iron from Mossaberg, Nora District.
410	5*b*	Ore from Mossaberg, roasted by means of waste combustion gases from the high furnace.
411	6	Magnetic iron ore from Bispberg, County of Dalecarlia.
		COALS OF NEW ZEALAND.
412–14	1, 2, 3	Specimens of coal from New Zealand. *Presented by Captain Stokes, R.N.*
		PATENT FUELS, &c.
415–16	1, 2	Specimens of patent fuel made by impregnating small coal with tar.
417–18	"	Coke from ditto.
		[N.B.—In this case are also two safety lamps, or "Davys."]

WALL-CASE B.

Containing fossil-wood, lignites, peat-charcoal and peat-ash, bog-butter; products illustrative of the destructive distillation of wood, peat, and coal; coals, fire-clays, iron stones, and specimens of the rocks of the Coal Measures from the various Irish Coal-fields; iron ores from various Irish non-carboniferous localities; pig-iron manufactured in Ireland with coal, peat, and wood-charcoal; limestone used as flux and high furnace cinder.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		SILICIFIED WOOD, LIGNITE, AND AMBER.
1–5	1	Silicified wood from Randalstown, county of Antrim.
6–10	2	Lignite, from Sandy Bay, Antrim.
11	3	Lignite, from Rasharking.
12	4	Ditto from Mount Druid, Antrim.
13–20	5	Lignite and amber from the County of Derry.
21	6	Lignite in pipe clay from Ballymacadam, Caher, county of Tipperary.
		VARIOUS SPECIMENS OF PEAT, CHIEFLY FROM THE FLAT BOGS IN THE CENTRE OF IRELAND; SPECIMENS OF THE PEAT-CHARCOAL AND ASH WHICH THEY YIELD.
22, 23	1	Exceedingly light spongy surface peat, from the immediate neighbourhood of the town of Monasterevan, County of Kildare.
24, 25	„	Charcoal from peat No. 1.
26	„	Ash from ditto.
27, 28	2	Fibrous or flow peat, from Mount Lucas bog, one mile south of Philipstown, King's county.
29, 30	„	Charcoal from peat No. 2.
31	„	Ash from ditto.
32, 33	3	Moderately dense peat, from Mount Lucas bog, King's County.

Red Numbers on Specimen.	Black Numbers on Specimen.	
34, 35	3	Charcoal from peat No. 3.
36	„	Ash from ditto.
37, 38	4	Fibrous or flow peat, from Tichnevin, county of Kildare.
39, 40	„	Charcoal from peat No. 4.
41	„	Ash from ditto.
42, 43	5	Surface peat, from Derrymullen, near Robertstown (formerly the station of the Irish Amelioration Society).
44, 45	„	Charcoal from peat No. 5.
46	„	Ash from ditto.
47, 48	6	Dense peat, from Derrymullen, county of Kildare.
49, 50	„	Charcoal from peat No. 6.
50	„	Ash from ditto.
51–54	7	Light surface peat, from the Wood of Allen, which forms part of the great Timahoe bog, about two miles from Robertstown, county of Kildare.
55, 56	„	Charcoal from peat No. 7.
57	„	Ash from ditto.
58-61	8	Middle layer of light surface peat, from the Wood of Allen, about two miles from Robertstown.
62, 63	„	Charcoal from peat No. 8.
64	„	Ash from ditto.
65, 66	9	Lower layer of the light surface peat, from the Wood of Allen, county of Kildare.
67	„	Charcoal from peat No. 9.
68	„	Ash from ditto.
69–71	10	Good compact peat, from Riversdale Bog, near the town of Kinnegad, and close to Hyde Park Demense, county of Westmeath.
72–74	„	Charcoal from peat No. 10.
75	„	Ash from ditto.
76–79	11	Exceedingly hard black peat, from Baltinoran and Rawson bogs, close to the town of Kinnegad, county of Westmeath.
80	„	Charcoal from peat No. 11.
81	„	Ash from ditto.
82–84	12	Very dense dark brown peat, from Anadruce and Cloncreim, on the Royal Canal, about one mile from Hyde Park, county of Westmeath.
85–87	„	Charcoal from peat No. 12.
88	„	Ash from ditto.
89–91	13	Rather dense peat, from the bogs of Rathconnell, Wood Down, and Great Down, two miles east of Mullingar, county of Westmeath.
92–94	„	Charcoal from peat No. 13.
95	„	Ash from ditto.

Red Numbers on Specimen.	Black Numbers on Specimen.	
96–99	14	Fibrous peat, from the upper layer of the bog in the immediate neighbourhood of Banagher, King's County.
100–1	,,	Charcoal from peat No. 14.
102	,,	Ash from ditto.
103–6	15	Rather compact peat, of a reddish brown colour, from the immediate neighbourhood of Banagher.
107–8	,,	Charcoal from No. 15.
109	,,	Ash from ditto.
110–13	16	Dense fibrous peat, from red bog in the immediate neighbourhood of Banagher.
114–15	,,	Charcoal from peat No. 16.
116	,,	Ash from ditto.
117–20	17	Fibrous, or flow peat, from Clonfert Bog, near the mouth of the River Suck, county of Galway.
121–24	,,	Charcoal from peat No. 17.
125		Ash from ditto.
126–28	18	Rather compact peat, of a light reddish brown colour, from Clonfert Bog, near the mouth of the River Suck, county Galway.
129	,,	Charcoal from peat No. 18.
130	,,	Ash from ditto.
131–36	19	Exceedingly dense dark blackish brown peat, from Athlone Bog, county of Roscommon.
137–40	,,	Charcoal from peat No. 19.
141	,,	Ash from ditto.
142–45	20	Dense peat, of a blackish brown colour, most probably from either Curragh or Clonburne Bogs, near Shannon Bridge, at the mouth of the River Suck, county of Roscommon.
146–47	,,	Charcoal from peat No. 20.
148	,,	Ash from ditto.
149–52	21	A dense peat, of a dark reddish brown colour, employed as fuel in the steam-vessels on the Middle Shannon, and obtained from the bogs along that river.
153–54	,,	Charcoal from peat No. 21.
155	,,	Ash from ditto.
156–59	22	Light fibrous peat, of a reddish brown colour, employed as fuel in the steam-vessels on the Middle Shannon, and obtained from the bogs along that river.
160–63	,,	Charcoal from peat No. 22.
164	,,	Ash from ditto.
165–68	23	Very dense peat, of a blackish brown colour, used as fuel in the steam-vessels on the Middle Shannon.

Red Numbers on Specimen.	Black Numbers on Specimen.	
169–71	23	Charcoal from peat No. 23.
172	„	Ash from ditto.
173–76	24	Very dense blackish brown compact peat, employed as fuel in the steam-vessels on the Middle Shannon.
177–79	„	Charcoal from peat No. 24.
180	„	Ash from ditto.
181-84	25	Rather dense reddish brown peat, employed as fuel in the steam-boats on the Middle Shannon.
185–86	„	Charcoal from peat No. 25.
187	„	Ash from ditto.
188–91	26	Rather compact and moderately dense peat, employed as fuel in the steam-boats on the Middle Shannon.
192–93	„	Charcoal from peat No. 26.
194	„	Ash from ditto.
195–98	27	Exceedingly dense peat, of a jet black colour, employed as fuel in the steam-boats on the Middle Shannon.
199-200	„	Charcoal from peat No. 27.
201	„	Ash from ditto.
202–9	28	Specimens of dense turf from Tarbert, county of Kerry, presented by the Rev. Mr. Fitzgerald.
210–15	29	Specimens of turf charcoal, presented by Mr. Alloway, Ballybrittas, Queen's county.
		SPECIMENS OF COMPRESSED PEAT PREPARED BY VARIOUS PROCESSES.
		Samples of compressed peat and of the natural peat from which it was obtained, presented by Capt. Henry Goold.
216	1	Natural peat.
217	2	Compressed peat from No. 1.
218	3	Charcoal from compressed peat No. 2.
219–23	4–8	Specimens of compressed peat made by Hayes' process.
224–25	9	Samples of turf compressed by the process of J. Mannhardt, of Munich, Bavaria.
226–27	10	Specimens of compressed peat, Hodgson patent.
		SPECIMENS OF BUTTER FOUND IN PEAT BOGS, AND COMMONLY KNOWN AS "BOG BUTTER."
228-29	1, 2	Specimens of bog butter found in the bog of Allen.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		SERIES OF SPECIMENS ILLUSTRATIVE OF THE PRODUCTS OF THE DESTRUCTIVE DISTILLATION OF PEAT.
230	1	Peat charcoal employed as manure.
231	2	Peat charcoal employed in dusting moulds for casting.
232	3	Peat tar.
233	4	Rectified paraffine.
234–36	5	Pressed paraffine.
237–42	6	Candles made from paraffine.
243	7	Oil obtained by distillation from turf, called in commerce "fixed oil," used for cleaning and oiling machinery.
244	8	Oil obtained by distillation of turf, called "camphine," used as lamp oil, &c.
245	9	Lightest and most volatile oil obtained in the distillation of turf, applicable as a solvent for caoutchouc and gutta percha.
246	10	Methylic alcohol obtained from the distillation of turf. Commercial names: Wood Spirit, Pyroxilic Spirit or Naphtha, used as a solvent in making varnish, &c.
247	11	Acetic acid or vinegar (specific gravity, 1·018), obtained by the distillation of turf, and made from purified acetate of soda and redistilled.
248–50	12	Impure ammoniacal salts, from the distillation of peat.
251–52	13	Refined ammoniacal salts, from the distillation of peat.
		SPECIMENS OF THE BITUMINOUS AND ANTHRACITE COALS, FIRE-CLAYS, IRONSTONES, AND OTHER ASSOCIATED MINERALS AND ROCKS ILLUSTRATIVE OF THE GEOLOGICAL STRUCTURE OF THE IRISH COAL FIELDS.
		A. COALS, &c.
		a. ANTRIM OR BALLYCASTLE COAL FIELD (*Bituminous Coal*)
253	1	Potter's clay, Ballycastle Colliery.
254	2	Fire clay from ditto.
255–56	3	Coal shale from ditto.
257	4	Bituminous coal from ditto. West Mine, main seam coal, four feet six inches thick.
258–59	5	Bituminous coal from the same locality.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		b. TYRONE COAL FIELD (*Bituminous Coal*).
260	1	Bituminous coal from Annagher.
261	2	Bituminous coal from Drumglass.
262–64	3–5	Ditto ditto.
265–70	6	Splint coal from five-foot coal, Barclay pit, townland of Lisnastrane, parish of Clonoe.
271–74	7	Shining seam coal from the townland of Annagher, parish of Clonoe.
275	8	Screened culm of the nine-foot seam, Coal Island Colliery.
276–78	9	Five-foot coal, Barclay pit, W., townland of Lisnastrane, parish of Clonoe.
279–84	10–12	Specimens of coal from the same locality.
285	13	Fire clay from Coal Island.
286–87	14	Bituminous coal from ditto.
288	15	Specimen of the "crow" coal employed for burning fire-bricks and tiles at Coal Island.
289–91	16, 17	Fire clay, Coal Island.
292–93	18, 19	Bituminous coal, Coal Island.
294–96	20	Carboniferous shale from ditto.
297	21	Screened culm of the five-foot seam of Coal Island Colliery.
298	22	A large lump of coal from Coal Island.
		c. CAVAN ANTHRACITE COAL.
		Specimens of Anthracite coal from the Lower Silurian rocks in the townland of Kill, county of Cavan, probably the same as that of Dumfries in Scotland. Presented by E. Hudson, Esq.
299-301	1	Anthracite coal, Kilnalesh, near Ballyjamesduff.
302–8	2	Anthracite, townland of Kill.
		d. CONNAUGHT COAL FIELD (*Bituminous Coal*).
309–11	1	Bituminous coal from Meenashama pit, county of Leitrim.
312–14	2, 3	Bituminous coal from Seltnaveena pit, county of Leitrim.
315	4	Specimens of the coal of the "third seam" from the detached field, north of the Arigna Valley, Seltannaskeagh Colliery, county of Leitrim.
316–17	5	Specimen of coal from Seltnaveena pit.
318	6	Specimen of coal from the same, but the exact locality not given.

Red Numbers on Specimen.	Black Numbers on Specimen.	
319	7	Specimens of the "kelve" or slaty coal forming the top of the seam in contact with the roof.
320–24	8–12	Coal from the same locality.
325–27	13	Carboniferous shale.
328–29	14	Specimens of the coke made from the third seam coal, Seltannaskeagh Colliery.
330–33	15–17	Specimen of coal from Seltannaskeagh Colliery, county of Leitrim.
334	18	Specimen of the coal of the third seam, showing the character of the superior quality of the southern division of the Connaught coal field, Gubarruda Colliery, valley of Arigna.
335	19	Specimen of the "Rover coal" from the Rover Colliery, valley of the Arigna, townland of Lower Rover, county of Roscommon.
		e. MUNSTER COAL FIELD (*Anthracite or Stone Coal*).
336–37	1, 2	Specimens of the peculiar coal underlying the fire-clay, Lisnacon Colliery.
338	3	Specimens of the riddled culm from the "fourpenny vein," Lisnacon Colliery, Kanturk, county of Cork.
339	4	Specimens of the culm of the "sweet vein," used for burning lime, from Dromagh Colliery, Kanturk, county of Cork.
340	5	Specimen of the riddled culm of the "sweet vein," Lisnacon Colliery.
341–43	6, 7	Specimen of the "sweet vein" coal, showing the peculiar joints in the coal, called locally "backs," Lisnacon Colliery.
344	8	Specimen of the coal of the "sweet vein," showing the *kelve* or slaty coal close to the roof of the seam, Lisnacon Colliery.
345–46	9	Specimen of the coal of the "sweet vein," illustrative of its different characters, Lisnacon Colliery.
347	10	Specimen of the coal of the "fourpenny vein," Lisnacon Colliery.
		f. LEINSTER COAL FIELD (*Anthracite or Stone Coal.*)
348–52	1–5	Specimens of anthracite from Rushes Colliery, Queen's County.
353–54	6, 7	Coal seat or fire-clay underlying the three-foot coal at Doonane Colliery.

Red Numbers on Specimen.	Black Numbers on Specimen.	
355–60	8–10	Specimens of coal from the same locality.
361–64	11	Underlying fire-clay or "coal seat" of the four-foot coal, Glen Colliery.
	12, 13	At the end of the Lower South Gallery will be found the two following specimens, showing the relative thickness of the beds of coal at the Castlecomer Collieries.
		1. Section of the "three-foot coal," with fire-clay, forming the "coal seat," Doonane Colliery, Castlecomer.
		2. Section of the "four-foot coal," Jarrow Colliery, Castlecomer.
		Presented by J. B. Wandesforde, Esq.
		Specimens of the Rocks associated with the Kilkenny Coal Measures.
365–67	1	Quartz vein in the four-foot coal, Glen Colliery.
368–70	2	Grit, containing carbonate of iron, from the coal measures of Glen Colliery.
371–74	3	Shale overlying the coal and containing impressions of plants, Skehana Colliery, county of Kilkenny.
375–77	4	Sandstones of the coal measure, Skehana Colliery.
378–80	5	"Seat rock" underlying the coal, from Skehana Colliery.
381–82	6	Underlying fire-clay or "coal seat" of the four-foot coal, Jarrow Colliery, county of Kilkenny.
383–85	7	Upper sandstone from ditto.
		Supplementary Collection of Coals from the Castlecomer Coal-field, collected by the Officers of the Geological Survey of Ireland.
386–87	1*a*, 2*a*	"841, 842." Anthracite coal, Glen Colliery.
388–89	3*a*, 4*a*	"843, 844." Anthracite coal, Jarrow Colliery, county of Kilkenny.
390–92	5*a*–7*a*	"845, 846, 847." Coal in "coal seat," Jarrow Colliery.
393–94	8*a*, 9*a*	"848, 849." Slate and "seat" rock underlying coal, Jarrow Colliery.
395	10*a*	"850." Anthracite coal from Skehana Colliery, county of Kilkenny.

Red Numbers on Specimen.	Black Numbers on Specimen.	
396	11*a*	"851." Anthracite, Monteen Colliery, county of Kilkenny.
397	12*a*	"852." Anthracite, Cretty Colliery, Queen's county.
398	13*a*	"853." Anthracite, Holly Park Colliery, Queen's county.
399	14*a*	"854." Anthracite, Massford Old Colliery, Kilkenny county.
400	15*a*	"856." Anthracite, Geneva Colliery, county of Carlow.
		g. TIPPERARY EXTENSION OF LEINSTER COAL FIELD (*Anthracite or Stone Coal*).
401–3	1–3	Specimens of the coal of the upper seam from Boulintlea District, Slieve Ardagh Colliery.
404–9	4–9	Anthracite coal, Brook Colliery.
410–14	10	Anthracite, from the Lower Silurian rocks, at Upper Church, eight miles W. of Thurles, county Tipperary.
415	11	Specimen showing the character of the upper seam of coal as usually found in faults, and close to the dislocation of the strata, Slieve Ardagh Colliery.
416–19	12–14	Small coal or culm and "shining balls," used as fuel for domestic purposes, Earl's Hill Colliery, Slieve Ardagh.
420	15	Specimens of the culm used for domestic purposes, from the Boulintlea District.
421	16	Specimen of the culm used for burning lime, from the Boulintlea District.
422	17	Small coal or culm used for burning lime, Glengoole Colliery.
423	18	Small coal or culm used for burning lime, Earl's Hill Colliery.
424–25	19	Specimens of culm used for burning lime, from Glengoole Colliery.
426	20	Specimens illustrative of the variations in quality which the "Firing culm seam" sometimes undergoes.
427–38	21–32	Various specimens of fire-clay and other rocks in connexion with the Slieve Ardagh Colliery.
439–47	33–37	Specimens of coal and of various rocks connected with the Coalbrook Colliery.
	38, 39	N.B.—At the end of the Lower South Gallery will be found two large blocks of Anthracite, showing the thickness of the bed at Earl's Hill Colliery, Slieve Ardagh.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		Illustrations of the Products of the destructive Distillation of Coal.
448	1	Crude coal tar.
449	2	Crude naphtha.
450	3	Oil from naphtha still.
451	4	Distilled tar from retort after distilling off naphtha.
452	5	Pitch oil (first running of still).
453	6	Coke oil.
454	7	Crude shale spirit.
455	8	Rectified coal naphtha.
456	9	Rectified coal naphtha.
457	10	Paraffine oil obtained from cannel coal.
458	11	Paraffine obtained from cannel coal.
459	12	Pitch obtained from the distillation of coal tar.
460	13	Charcoal remaining from pitch.
		Series of Specimens showing the Comparative Value of Coals employed in the Production of Volatile Oils and Gas.
461	1	Boghead coal.
462	2	Newcastle coal. Pelton main coal.
463	3	Mickley coal, Newcastle.
464	4	Carlisle coal.
465	5	Wigan cannel coal.
		Illustrations of the Products of the destructive Distillation of Wood.
		(Comparative Collection).
466	1	Wood specimen.
467	2	Wood charcoal.
468	3	Wood tar.
469	4	Wood naphtha.
470	5	Crude pyroligneous acid.
471	6	Distilled pyroligneous acid.
472	7	Acetate of lime (black lime ley).
473	8	Acetate of lime (white lime ley).
474	9	Acetate of soda.
475	10	Purified acetate of soda.
476	11	Acetic acid.
477	12	Brown sugar of lead.
478	13	White sugar of lead.
479	14	Verdigris.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		B. Ironstones, Fire-clays, Limestones used as Flux, Pyrites, Pig-Iron, and High-furnace Cinder.
		ANTRIM COAL FIELD.
480–81	1	Massive clay ironstone, from the beds associated with coal measures. Ballycastle Colliery.
482	2	Ferruginous shale, from the coal measures, Ballycastle.
483	3	Ironstone band, Fair Head, Ballycastle.
484	4	Ironstone band, calcined, from the same locality.
485	5	Ironstone balls.
486–88	6	Ferruginous shale, Ballycastle.
489–90	7	Ferruginous sandstone, from the coal measures, Ballycastle.
491–92	8	Clay ironstone balls (earthy carbonate of iron), Ballycastle.
493–95	9	Nodules of red hæmatite, Fair Head, Ballycastle.
496-506	10–12	Band ironstone.
		The above series of iron ores was presented to the Museum by W. Townsend, Esq.
		TYRONE COAL FIELD.
507–11	1	Clay ironstone balls found in the grey slate clay of the coal measures, Coal Island.
512–16	2	Massive clay ironstone (earthy carbonate of iron passing into red hæmatite), Coal Island Colliery.
		CONNAUGHT COAL FIELD.
517–19	1, 2	Specimens of the limestone used as "flux" at Drumshambo Charcoal Iron Works about the year 1766.
520–21	3	Specimens of the calcined clay ironstone, from Slieve-an-Iërin, or Iron Mountain, employed at the Drumshambo Charcoal Iron Works, 1766.
522–29	4, 5	Clay ironstone balls (earthy carbonate of iron) from Slieve-an-Iërin, county of Leitrim.
530–32	6, 7	Specimens of the cinder of the charcoal iron made about the year 1766.
533–39	8	Samples of grey pig iron made at the Arigna Iron Works, county Roscommon.
540–45	9, 10	Specimens of the cinder or slag from the Arigna Iron Works, county Roscommon.

Red Numbers on Specimen.	Black Numbers on Specimen.	
546–48	11	Specimens of calcined massive clay ironstone (earthy carbonate of iron), from the beds at Cornagee, valley of the Arigna.
549–51	12	Specimens of calcined ironstone balls, from Altagowlan and from the bed of the Arigna river.
552–55	13, 14	Specimens of clay ironstone balls found in beds in the shale at Altagowlan, valley of the Arigna, county of Leitrim.
556–57	15	Clay ironstone balls, forming thin bands in the black shale over the coal and underlying the "great sandstone" on the colliery road above the Arigna Iron Works.
558–60	16	Grey and white pig-iron, made at the Creevelea Iron Works, from the Tullinwannia bed, and ball clay ironstone.
561–62	17	Specimen of pig-iron from the same locality.
563–65	18	Limestone employed as "flux" in the manufacture of pig-iron at the Creevelea Iron Works, county Leitrim.
566–72	19, 20	Cinder or slag, obtained with the ball, and massive red ironstone, found at Tullinwannia, and smelted at the Creevelea Iron Works.
573	21	Clay ironstone balls, overlying the alum shale, and underlying the coal measures, Tullinwannia.
574–76	22	Specimens of the infusible mass of the iron slag, commonly called a "Horse," which accumulates in the bottom of furnaces, and stops, or, as it is commonly called, "gobs up" the furnace. Arigna Iron Works.
577–79	23	Massive clay ironstone, from the beds resting on the alum shale, Tullinwannia, Creevelea Iron Works.
580–81	24, 25	Calcined clay ironstone ball, from Tullinwannia, calcined at the Creevelea Iron Works.
582	26	Decomposing alum shale, overlying the fire-clay. Tullynamoyle, Creevelea Iron Works.
583–85	27	Fragments of limestone balls, which occur in a blue calcareous shale at Tullynamoyle, Creevelea Iron Works.
586	28	Clay ironstone ball, enveloped by a thin shell of Iron pyrites. Cornagee, valley of the Arigna, county Leitrim.
587–89	29	Fragments of clay ironstone balls, showing the external rind or envelope of iron pyrites. Cornagee.

Red Numbers on Specimen.	Black Numbers on Specimen.	
590	30	Hard slate, resting on fire-clay, which decomposes into the accompanying alum ore. Tullynamoyle.
591–92	31	Fire-clay, resting upon ferruginous shale, and underlying the decomposing alum shale. Tullynamoyle.
		c. MUNSTER COAL FIELD.
593	1	Hæmatite, from Ironstone Hill, one mile from Mallow.
594–96	2	Massive clay ironstone, forming beds or bands in the overlying shale of the "sweet vein" at Dromagh Colliery, Kanturk.
597–98	3	Clay ironstone ball, from the coal measures of Dromagh.
599	4	Massive clay ironstone, forming thin bands in the shale overlying the "fourpenny vein" at Lisnacon Colliery, near Kanturk.
600–2	5	Inferior clay ironstone, from the coal measures at Dromagh Colliery, Kanturk.
603–4	6	Nodules of iron pyrites, occurring in the "sweet vein," Dromagh Colliery.
		LEINSTER COAL FIELD.
605–8	1	Clay ironstone balls, found in the shale of the coal measures, near Castlecomer.
609–10	2	Specimens of clay ironstone, Jarrow Colliery, county of Kilkenny.
611–13	3–5	Clay ironstone, from Skehana Colliery.
614–15	6	Clay ironstone, from Massford Colliery.
616	7	Nodules of rhombic pyrites, from the "four-foot" coal. Jarrow Colliery.
617–18	8	Nodules of rhombic pyrites, found embedded in the coal. Doonane, Queen's County.
619	9	Nodules of rhombic pyrites, found embedded in the coal. Glen Colliery.
620–22	10, 11	Clay ironstone balls, found in the shale of the coal measures at Doonane.
		Supplementary Collection of Clay Ironstones from the Castlecomer Coal-field, collected by the Officers of the Geological Survey of Ireland.
623 624–26	16*a*–19*a*	"837, 838, 839, 840." Clay ironstone from Skehana Colliery.
627	20*a*	"855." Clay ironstone from Massford Old Colliery.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		TIPPERARY EXTENSION OF LEINSTER COAL FIELD.
628	1	Nodules of bisulphuret of iron (rhombic pyrites), found embedded in the coal of the under seam, called locally "brass balls."
629	2	Clay ironstone balls, found in the shale forming the roof of the upper seam.
630–33	3	Clay ironstone, forming thin beds, interstratified with the shale forming the roof of the upper seam.
634	4	Fire-clay, forming the main "coal seat" at Earl's Hill Colliery, showing the presence of hæmatite.
635–36	5	Nodules of hæmatite (*impure* hydrated peroxide of iron) found in the main "coal seat" at Earl's Colliery.
		IRON ORES FROM VARIOUS IRISH LOCALITIES, NOT INCLUDED IN THE FOREGOING CARBONIFEROUS DISTRICTS.
		King's County.
637	1	Ferruginous peat, used as an agent for the purification of coal gas, &c., used to adulterate guano?
		County Limerick.
638	1	Hæmatite from Ballingard, seven miles from Limerick.
		County Longford.
639–40	1, 2	Specimen of brown hæmatite from Cleenragh, barony of Granard, presented by Mr. Porter.
641–43	3	Brown hæmatite from the same locality, presented by C. Miller, Esq.
		Queen's County.
644	1	Hæmatite, from Dysartenos, near the Rock of Dunamase.
645–46	2	Dysartenos hæmatite, calcined.
647–49	3	Ferruginous clay, derived from the decomposition of beds of hæmatite, interstratified with bands of grit. Dysartenos.

Red Numbers on Specimen.	Black Numbers on Specimen.	
650–51	4	Bog iron ore (*impure* hydrated peroxide of iron).
652	5	Pig-iron, made from bog iron ore with wood charcoal, Clonmore, co. Mayo.
653–54	6	Pig-iron, made with *raw turf*, from a mixture of the clay ironstone of the Kilkenny coal measures and hæmatite from Dysartenos, Queen's county.
655-60	7	Specimens of cinder obtained in making the above pig-iron.
		County Wexford.
661	1	Magnetic iron ore, from Courtown Harbour.
		County Wicklow.
662	1	A large ball of magnetic iron ore (*in the low corner of the case*) from the working in search of lead made at Ballintemple, near the Wooden Bridge.
663–64	2	Magnetic iron ore, containing copper pyrites, from old workings in search of copper at Moneyteige, South.
665	3	Gossanlike hæmatite, accompanying the magnetic iron at Ballintemple, near the Wooden Bridge.
666	4	Magnetic iron ore, partially decomposed, from the working for lead at Ballintemple.
667–69	5	Balls of magnetic iron, and portion of the same ore broken off. Ballintemple.
670-71	6	Brown hæmatite, from Kilbride.
672–80	1–9	SERIES OF NINE SPECIMENS ILLUSTRATIVE OF THE STAGES OF MANUFACTURE OF SHOVELS MADE FROM SCRAP-IRON. [PRESENTED BY MESSRS. M'GARRY AND SONS, PALMERSTOWN MILLS, COUNTY OF DUBLIN.]

LOWER CROSS GALLERY.

NORTH END OF THE GALLERY.

SERIES OF MODELS AND SPECIMENS ILLUSTRATING THE VARIOUS PROCESSES FOR EXTRACTING IRON FROM ITS ORES, AND CONVERTING IRON INTO STEEL.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		EXTRACTION OF IRON.
1	1	Model of a Scotch blast iron furnace in which the hot blast is used.
		MANUFACTURE AND PRODUCTS OF STEEL. *See also Table-Case* 1, *p.* 34.
2	1	Dissecting model of a converting furnace for the manufacture of blister steel by the English, or cementation process.
		N.B.—The glass-case upon which the model stands contains the following specimens :—
3	6	Firingstone, a kind of sandstone from the coal measures, for lining converting furnace.
4	22	Charcoal used in the cementing process.
5	23	Puddling furnace cinder, one of the materials used in the converting furnace.
6	24	Cinder formed in the converting furnace.
7	2	Model of melting house for making cast steel.
		N.B.—The glass-case upon which the model stands contains the following specimens :—
8	7	New melting-pot with lid and support, used to melt the blister steel.
9	8	An old melting-pot and lid which has been used in melting steel.
10	9	Ingot mould in which the steel is cast into bars for hammering, rolling, &c.
11	10	Ingot of cast steel.
12	3	Forge-hearth for heating steel ingots, preparatory to being hammered into bar steel.
13	4	Hearth for heating steel used in rolling sheet steel.

Red Numbers on Specimen.	Black Numbers on Specimen.	
14	5	Model, showing— *a.* A set of tilt hammers for forging steel. *b.* Shears for cutting bars. *c.* System of rolls for making rods and bars. These models represent the actual machinery employed in the Works of Messrs. Naylor and Wickers, Sheffield, under whose direction they were specially made for the Museum.

STAIRS LEADING FROM LOWER CROSS GALLERY TO LOWER NORTH GALLERY.

Specimens of Artistic Castings in Iron.

See also Table-case 1, *p.* 33.

Near Wall-Case A (*Lower N. Gallery, right hand*) **the following specimens are exhibited:—**

Red	Black	
1	1	British Coat of Arms, in bronzed cast-iron. [Presented by the Falkirk Iron Company, Scotland.]
2	2	Statuette of the late Sir Robert Peel, in bronzed cast-iron. [From the Coalbrookdale Works.]
3	3	Plate, in bronzed cast-iron, ornamented with wreathed foliage in imitation of Florentine work. [Presented by Mr. W. Pierce, Jermyn-street, London.]
4	4	Iron casting, in alto-relievo, after Leonardo da Vinci. [From the Royal Iron Foundry of Berlin.]
5	5	Casting of part of a gate in imitation of hammered work in wrought iron, Renaissance style, probably Florentine. [Presented by the Coalbrookdale Company.]
6	6	Cast-iron statue of a Nymph. [Presented by the Falkirk Iron Company.]
7, 8	7	Iron casting, after the Pompeii Mosaic "Cave Canem," at the entrance of the Prothyrum (vestibule) of the Tragic Poet's house. [Presented by the Coalbrookdale Company.]
9–13	8	Plates of cast-iron for flooring, &c. [Presented by the Coalbrookdale Company.]

Red Numbers on Specimen.	Black Numbers on Specimen.	
		Near Wall-Case B (*Lower N. Gallery, left hand*).
		Specimens of Railway Bolts, Railway Carriage Springs, Telegraphic Cables, &c.
14	1	On a board: a collection of 158 specimens of railway screws and railway bolts. [Presented by Mr. John Hawkins, manufacturer, in Birmingham.]
15	2	Specimens of submarine telegraphic cables. [Presented by R. Newall and Co., Gateshead-on-Tyne, patentees and manufacturers.]
		Total length of cable.
		1. Prince Edward's Island, Newfoundland, ... 150 miles.
		2. England and Holland, . . 550 "
		3. Across the Mississippi, . . 2 "
		4. Denmark, across the Belt, . 16 "
		5. Dover and Calais, . . . 25 "
		6. Dover and Ostend, . . . 70 "
		7. Port Patrick and Donaghadee, 25 "
		8. Across the Zuyderzee, . . 5 "
		9. England and Holland, . . 550 "
16–25	3	Collection of railway carriage springs.
26	4	Buffer-plate for railway carriage.
27	5	Cramping-nut for ditto. [Deposited in the Museum by the Royal Dublin Society.]

LOWER NORTH GALLERY.

TABLE-CASE 1.

Containing: 1, Specimens of Ornamental Cast-iron; 2, Specimens of Swedish Iron and Steel, and Tools used in the Manufacture of Cast-steel.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		SIDE MARKED A.
		MANUFACTURE AND PRODUCTS OF STEEL.
		(*See also* p. 31.)
1	25	Scales formed in forging steel.
2		Card of models of tools used in the melting-house in the manufacture of cast-steel.
	11	Props for supporting forge hammer.
	12	Melting-pot.
	13	Pulling-out tongs.
	14	Charger for feeding melting-pot.
	15	Teaming tongs.
	16	Poker for arranging the fire.
	17	Bars for removing slags from melting-pots.
	18	Tongs for removing the ingots.
	19	Ingot moulds with binding cramps and wedges.
	20	Furnace hammers.
	21	Ladle to smoke the ingot moulds with tar to prevent the adhesion between the melted steel and the mould.
3-30	26	Collection of ends of bars of Swedish iron, upon which are stamped the marks of the various forges from which the iron comes, with corresponding bars ends of blister steel.
31-41	27	Turning tools.
42, 43	28	Nail cutters.
44	29	Cast-steel in bars: suited for dies.
45	30	" " axes.
46-49	31	" " edge tools.
50-52	32	" " drills.
		SIDE MARKED B.
53-55	33	" " taps.
56-58	34	" " engineering chisels.
59, 60	35	" " files.

Red Numbers on Specimen.	Black Numbers on Specimen.			
61	36	Cast-steel in bars :	suited for	plane irons.
62	37	,,	,,	coach springs.
63, 64	38	,,	,,	gouges.
65	39	Cast-steel in sheets :	,,	circular saws.
66	40	,,	,,	reaping hooks.
67	41	,,	,,	shovels.
68	42	,,	,,	springs.
69	43	,,	,,	engravers' plates.
70	44	,,	,,	ginsaws.
71	45	,,	,,	bottle-jack springs.
72–79	46	,,	,,	pens.
80	47	Swedish iron :	,,	screws.
81–107	48	On a card :		
		Best cast-steel,	,,	drawing wire.
		,,	,,	hackle pins, files, spirals, springs, needles, &c.
108–15	49	Extra cast-steel,	,,	for turning tools.
116–17	50	,,	,,	mill picks.
118	51	,,	,,	dies.
119–20	52	,,	,,	planing tools.
121	53	,,	,,	axes,
122	54	,,	,,	razors.
123–25	55	,,	,,	nail cutters.
126	56	,,	,,	edge tools.
127–28	57	,,	,,	gouges.
129	58	,,	,,	plane irons.
130–31	59	,,	,,	chisels.
132–34	60	,,	,,	taps.
135–37	61	,,	,,	drills.
		[Presented by Messrs. Naylor and Wickers, Sheffield.]		
		ON THE TOP OF THE CASE.		
138	9	A Vase in cast-iron, after the antique. [From the Royal Berlin Iron Foundry.]		
		UPPER PART OF CASE.		
139–40	10	Broaches in cast-iron. [From the Royal Berlin Iron Foundry.]		
141	11	The dancing figure, after Leopold Robert's "The Harvesters."		
142	12	Two goats in cast-iron. [By Mr. Zimmerman, Frankfort on the Oder.]		
143	13	Specimen of iron casting from the sand ; imitation of Renaissance hammered work. [From Messrs. Hoole, Robson, and Hoob's, Green-lane Works, Sheffield. Presented by the Science and Art Department.]		

Red Numbers on Specimen.	Black Numbers on Specimen.	
144–52	1–9	A collection of screws made, according to Mr. M'Cormick's patent, by the pressure of red hot iron between chilled iron dies. [Presented by John Cameron, Esq., Fleet-street, Dublin.]

TABLE CASE 2.

Containing: 1. Specimens of Styrian "Natural Steel," and of British "Blister Steel." 2. A Collection of Cast-steel, Edge Tools, Hammers, Files, &c.

UPPER PART OF CASE.

1-44	1–44	Specimens of natural steel from the Imperial Austrian Works of Weyer, in Styria.

"NATURAL STEEL."

The justly celebrated steel made in Styria, Carniola, and the Tyrol, is obtained from cast-iron of extraordinary purity, made from sparry carbonate of iron or "Spathic Iron," which forms very thick beds amongst the Grauwacke rocks and Alpine limestones. Rich hæmatites, or hydrated peroxide of iron, occurring under similar circumstances, are also employed.

45–47	1–3	Specimens of British blister steel.

ILLUSTRATIONS OF SADDLERS' IRONMONGERY.

48–51	1	Stirrups in the various stages of making. [Presented by Messrs. T. and S. Pim, Mountmellick.]
52–54	2	Snaffle bits, ditto.
55–57	3	Bits, ditto.

SIDE MARKED A.

58–110		COLLECTION OF SPECIMENS OF CAST-STEEL AND EDGE TOOLS. [Presented by Messrs. Turton and Sons, Sheffield.]
	1	Iron for American axe.
	2	" " cut and double iron.
	3, 4	" Screw auger.
	5	Cast-steel for paring gouge.
	6	" for socket chisel.

Red Numbers on Specimen.	Black Numbers on Specimen.	
	7	Iron for mortice chisel.
	8	Mould for firmer chisel.
	9	Steel for mortice chisel.
	10	Cast-steel for firmer chisel.
	11	„ for millwright's chisel.
	12	Mould for millwright's chisel.
	13	Iron for socket chisel.
	14	Cast-steel for paring gouge.
	15	Cast-steel for paring chisel.
	16	Mould for ditto.
	17	Mould for socket chisel.
	18	Cast-steel for American axe.
	19	Mould for mortice chisel.
	20	Steel for screw auger.
	21	Mould for shell auger.
	22	Iron for mortice chisel.
	23	Imperial gouge.
	24	Long paring gouge.
	25	Mould for American axe.
	26	Imperial gouge.
	27	Millwright's chisel.
	28	Imperial chisel.
	29	Socket chisel.
	30	Cut-iron.
	31	Millwright's gouge.
	32	Mortice chisel.
	33	Long paring chisel.
	34	Double tool, paring and mortice chisel.
	35	Double tool, screw and shell auger.
	36	American axe.
	37	Mould for cut and double iron.
	38	Iron for American axe.
	39	Cast-steel for firmer gouge.
	40	Mould for back iron.
	41	Iron for American axe.
	42	Steel for back iron.
	43	Iron for shell auger.
	44	Cast-steel for cut and double iron.
	45	Iron for back iron.
	46	Mould for millwright's gouge.
	47	Steel for shell auger.
	48	Mould for firmer gouge.
	49	Mould for screw auger.
	50	Double iron.
	51	Eye for screw auger.
	52	Screw auger.
	53	Carpenter's shell auger.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		SIDE MARKED B.
111–19	1–9	Hammers.
120-203	1–83	Specimens of rasps and files, in cast-steel, from the Cyclops Iron Works, Sheffield. [Deposited by the Royal Dublin Society.]
		TABLE-CASE 3.
		Containing: 1. Specimens of Bar Iron, and Steel made therefrom and used for Needles, Chronometers, Musical Wires, Hackles, &c., and also various Specimens of these articles. 2. A Collection showing all the Stages of Manufacture in Needle Making. 3. A complete Series, illustrating the Manufacture of Steel Pens.
		UPPER PART OF CASE.
		ILLUSTRATIONS OF STEEL SPRINGS AND OF STEEL WIRE, AND ITS APPLICATIONS TO THE MANUFACTURE OF COMBS, HACKLES, &c.
1–9	1	Steel springs for carriage cushions, &c.
10	2	Small brass spring.
11–51	3	Box containing specimens of the best cast-steel wire, made from the cast-steel exhibited in the case.
52–78	4	Tray containing needles of every size for combs and hackles, used in the combing of wool and hackling of flax.
79	5	Large hackle for flax, mounted on a mahogany frame.
80	6	Small hackle for ditto, mounted on a mahogany and tin frame.
81	7	Part of a machine comb, for wool.
82–86	8	Smaller combs of different sizes, mounted on a brass frame, &c.
		[Prepared for the Museum by Messrs. Cocker and Sons, Atlas Works, Hathersage, Derbyshire.]
		SIDE MARKED A.
		ILLUSTRATIONS OF THE MATERIALS AND PRODUCTS OF THE MANUFACTURE OF MUSIC AND CHRONOMETER WIRES AND NEEDLES.
87	1	L. Bar iron.
„	2	L. Iron converted into steel.

Red Numbers on Specimen.	Black Numbers on Specimen.	
89	3	C.L. Bar iron.
90	4	C.L. Bar iron, No. 2, converted into steel.
91	5	Cast-steel from bar No. 2.
92	6	Cast-steel from bar iron, first quality.
93	7	H.L. Bar iron.
94	8	H.L. Bar iron converted into steel.
95	9	K.B. Iron.
96	10	K.B. Iron converted into steel.
97	11	K.B. Bar iron.
98	12	K.B. Bar iron converted into steel.
99	13	Cast-steel from K.B. iron.
100	14	Cast-steel from K.B. for second quality steel.
101	15	Extra best cast-steel for fine tools, &c.
102–06	16	Specimens of hammered steel.
107	17	Steel dust collected by powerful fans in the grinding of needle points, and which formerly caused the grinders' asthma.
		ILLUSTRATIONS OF STEEL WIRE.
108–13	18	A stand holding coils of steel wires of various sizes.
114	19	A wire drawer.
115	20	Chronometer wires.
116–17	21	Reel wires.
118	22	Music wires.
119–27	23	Cast-steel flat springs for ladies' hoops, &c.
128	24	CASE DIVIDED INTO 35 COMPARTMENTS, AND ILLUSTRATING ALL STAGES OF MANUFACTURE IN NEEDLE MAKING. 1. Wire cut the length of two needles. 2. „ straightened. 3. „ pointed. 4. „ stamped. 5. „ eyed. 6. „ threaded for filing. 7. „ filed on the sides. 8. „ broken in two. 9. „ filed on the head. 10. Needles prepared for drilling. 11. „ drilled when soft. 12. „ hardened. 13. „ tempered. 14. „ straightened. 15. Finishing, first emery. 16. „ second emery.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		17. Finishing, third emery.
		18. " fourth emery.
		19. " fifth emery.
		20. " glazed.
		21. " headed.
		22. " blued to drill.
		23. " drilled.
		24. " blue taken off.
		25. " first finish.
		26. " second finish.
		27. " third finish.
		28. " fourth finish.
		29. " papered.
		30. " labelled.
		31. " wrappered.
		32–35. Cards exhibiting various kinds of needles and wrappers used in the trade.
129–30	25	Tray containing two ladies' needle cases.
131–54	26–27	Trays containing four large needle boxes, two of them containing smaller ones, showing the various styles of ornamentation.
155–58	28	Four small boxes, ditto.
		[The whole of the Collection in this side of the case was also prepared for the Museum by Messrs. Cocker and Sons, Atlas Works, Hathersage, Derbyshire.]
		SIDE MARKED B
		ILLUSTRATIONS OF THE MANUFACTURE OF STEEL PENS. [Presented by J. Gillott, Manufacturer, Birmingham.]
159	1	Sheet of steel as obtained from the maker.
160	2	" cut into strips.
161	3	" annealed.
162	4	" with scales removed.
163	5	Rolled steel, ordinary thickness.
164	6	Rolled steel, very thin.
165	7	Scrap strips after the blanks are cut out.
166	8	Box in which the pens are hardened.
167	9	Pounded crucible, with which the pens are scoured.
168	10	A bottle of pen varnish, consisting of sheel-lac dissolved in spirit of wine and wood spirit.
169–70	11	Wheels employed for grinding and polishing pens.
171–72	12	Tools used in the process of grinding and polishing pens.

Red Numbers on Specimen.	Black Numbers on Specimen.	
	13	SERIES IA.—No. 303 PENS (NIB OR SLIP PENS).
173		1. Pen, cut out.
174		2. „ side slit.
175		3. „ pierced.
176		4. „ annealed.
177		5. „ marked.
178		6. „ raised.
179		7. „ hardened.
180		8. „ tempered.
181		9. „ scoured.
182		10. „ ground.
183		11. „ crossed.
184		12. „ slit.
185		13. „ coloured.
186		14. „ varnished.
	14	SERIES IB.—No. 351 PENS (NIB OR SLIP PENS).
187–200		Fourteen boxes representing the various stages of manufacture as in the former series.
	15	SERIES IIA.—15 BOXES OF THE ORDINARY BARREL OR MAGNUM BONUM PENS, IN THEIR VARIOUS STAGES OF MANUFACTURE.
201		1. Pen, cut out.
202		2. „ side slit.
203		3. „ pierced.
204		4. „ annealed.
205		5. „ marked.
206		6. „ raised.
207		7. „ turned over.
208		8. „ hardened.
209		9. „ tempered.
210		10. „ scoured.
211		11. „ ground.
212		12. „ crossed.
213		13. „ slit.
214		14. „ coloured.
215		15. „ varnished.
	16	SERIES IIB.—LARGE BLACK SWAN QUILL BARREL PENS.
216		1. Pen, cut out.
217		2. „ side pierced.
218		3. „ pierced.
219		4. „ side slit.

Red Numbers on Specimen.	Black Numbers on Specimen.	
220		5. Pen, annealed.
221		6. „ marked first.
222		7. „ marked.
223		8. „ raised.
224		9. „ turned over.
225		10. „ hardened.
226		11. „ tempered.
227		12. „ scoured.
228		13. „ straight ground.
229		14. „ cross grouud.
230		15. „ side cut.
231		16. „ slit.
232		17. „ coloured.
233		18. „ bright ground.
234		19. „ bright heel ground.
235		20. „ lackered.
		CARDS CONTAINING VARIOUS SERIES OF METALLIC PENS ISSUED BY MR. GILLOTT.
236	17	Sample card, containing a series of 75 steel pens issued in June, 1852.
237	18	Card of the 80 various kinds of pens issued in June, 1854.
238	19	Card of 54 pens issued in 1856.
239	20	Sample card, containing 58 metallic pens issued in 1856. "This sample card contains all the best quality metallic pens, in universal demand, as improved and revised during the past thirty years."

TABLE-CASE 4.

Containing: 1. Specimens illustrative of the various Methods of protecting Iron from Oxidation. 2. Irish Collection of the Ores of Iron used in the Arts, or possessing a scientific interest.

SIDE MARKED A.

SPECIMENS ILLUSTRATIVE OF THE VARIOUS METHODS OF PROTECTING IRON FROM OXIDATION, BY COATING WITH GLASS OR ENAMEL, &c.

1–8	1	Culinary ware, covered with enamel.
9–10	2	Iron pipes for water supply, covered with enamel.

Red Numbers on Specimen.	Black Numbers on Specimen.	
		SIDE MARKED B.
		SPECIMENS ILLUSTRATIVE OF THE VARIOUS METHODS OF PROTECTING IRON FROM OXIDATION, BY COATING WITH OTHER METALS.
11–25	1	Specimens of telegraph wires of various sizes.
26–49	2	Specimens of telegraph wires coated with zinc. [Presented by J. Morton and Co., Leeds.]
50	3	Specimen of plated wire cordage.
51–52	4	Ditto, coated with zinc.
53–59	5	Specimens of various kinds of wire cordage.
60–64	6	Ditto, coated with zinc. [Presented by R. S. Newal and Co., Gateshead-upon-Tyne.]
		UPPER PART OF CASE.
		COLLECTION OF IRISH SPECIMENS OF THE DIFFERENT ORES OF IRON EMPLOYED IN THE ARTS FOR THE PRODUCTION OF THE METAL, OR FOR OTHER PURPOSES.
65–66	1	Mispickel, arsenical iron pyrites, Faithlegg, Waterford.
67–70	2	Ditto, Faithlegg.
71–72	3	Iron pyrites on slate, Moneyteige, Wooden Bridge, Co. Wicklow.
73	4	Iron pyrites, Connoree Mines, Wicklow.
74	5	Iron pyrites on limestone, Co. Dublin.
75–77	6	Iron pyrites from Dungiven, Derry. Ditto, Dunhay, Derry. Ditto, Ballynascreen, Derry.
78-79	7	Cubic iron pyrites, with magnetic iron pyrites, Co. Fermanagh.
80	8	Magnetic iron pyrites, Moneyteige, Co. Wicklow.
81–82		Rib of iron pyrites and magnetic iron, Moneyteige.
83	9	Cast of iron pyrites in yellow sandstone, Kilkenny.
84–86	10	Iron pyrites in lower limestone shale, Co. Dublin.
87	11	Magnetic iron in slate, Croaghay, Croagpatrick.
88–90	12	Magnetic iron, Island Muck, Co. Antrim.
91	13	Magnetic iron, Courtown Harbour, Co. Wexford.
92	14	Magnetic iron sand, coast near Courtown Harbour, Co. Wexford.
93–94	15	Micaceous iron ore, Knockbrack, Co. Wexford.
95	16	Micaceous iron ore, Island Magee, Co. Antrim.
96	17	Micaceous iron ore, from Old Red Sandstone, Castlebridge, Co. Wexford.
97	18	Meteoric stone? Co. Limerick.
98–102	19	Brown hæmatite, Co. Derry.

Red Numbers on Specimen.	Black Numbers on Specimen.	
103–4	20, 21	Brown hæmatite, Glandore, Co. Cork.
105–06	22	Fibrous hæmatite ore, compact hæmatite, Glandore.
107	23	Brown hæmatite in concentric layers, Ballybunion Caves, Co. Kerry.
108	24	Reniform iron ore, said to be from the bed of the Dodder, Co. Dublin.
109–11	25	Brown hæmatite, Ramoan, Co. Antrim.
112	26	Bog iron ore, Lough Glynn, Co. Mayo.
113	27	Ditto.
114–21	28, 29	Impure ochreous hæmatite, &c., Sutton, Howth, Co. Dublin.
122–24	30	Red hæmatite, Ballinagard, Co. Limerick.
125	31	Ditto, Culfeightrim, Co. Antrim.
126	32	Carbonate of iron in quartz, Glendalough, Co. Wicklow.
127–28	33	Carbonate of iron (siderite), from great lode on south side of Waterfall in Glendalough, Co. Wicklow.
129	34	Carbonate of iron, Ramoan, Co. Antrim.
130	35	Carbonate of iron, Clonoe, Co. Tyrone.
131–36	36	Clay ironstone, earthy carbonate of iron, valley of the Arigna, Co. Leitrim.
137–38	37	Sparry iron ore with carbonate of lime, Dunmore.
139	38	Blue phosphate of iron found associated with bog iron ore in the Bog of Allen, Co. Kildare.
		[N.B.—A complete series of the ores and minerals of iron will be found included with the typical collection of minerals, Lower South Gallery.]

DUBLIN: Printed by ALEXANDER THOM, 87 & 88, Abbey-street,
For Her Majesty's Stationery Office.

Science and Art Department.

GOVERNMENT SCHOOL OF SCIENCE APPLIED TO MINING AND THE ARTS.

Industrial Museum of Ireland, Stephen's-green, East.

PROGRAMME

OF

EDUCATIONAL ARRANGEMENTS

FOR THE

SESSION OF 1866-1867.

Further information will be found in the separate Detailed Syllabus of the Courses of Lectures.

THE SESSION WILL BE OPENED ON THE 8TH OF OCTOBER.

DUBLIN:
PRINTED BY ALEX. THOM, 87 & 88, ABBEY-STREET,
FOR HER MAJESTY'S STATIONERY OFFICE.

1866.

Science and Art Department.

GOVERNMENT SCHOOL OF SCIENCE APPLIED TO MINING AND THE ARTS.

INDUSTRIAL MUSEUM OF IRELAND.

Director.

Sir ROBERT KANE, M.D., F.R.S., M.R.I.A.

Professors.

Physics, ... WILLIAM BARKER, M.D., M.R.I.A.

Chemistry, . . . WILLIAM K. SULLIVAN, PH.D., M.R.I.A.

Botany, ... GEORGE BUTLER BRADSHAW, F.R.G.S.I., Acting Pro. Tem.

Zoology, ... JOHN MORGAN, F.R.C.S.I., Acting Pro. Tem.

Geology, ... J. BEETE JUKES, M.A., F.R.S., M.R.I.A. (Local Director of Geological Survey of Ireland).

Analytical and Practical Chemistry, . ROBERT GALLOWAY, F.C.S.L. (Chemist to the Museum).

Curator of the Museum.

ALPHONSE GAGES.

Assistant Chemist.

WILLIAM PLUNKETT, F.C.S.L.

Clerk and Accountant.

GEORGE C. PENNY.—Office, Industrial Museum of Ireland.

GOVERNMENT SCHOOL OF SCIENCE APPLIED TO MINING AND THE ARTS, DUBLIN.

ROYAL EXHIBITIONS.

1. There are ten Royal Exhibitions of the value of £50 per annum entitling the holders to free admission to all the lectures and the Chemical Laboratory at the Government School of Science, to be held from year to year for three years, on the condition that the holder attends the lectures regularly during those years and passes the examinations required for the associateship of the School.

At the May, 1867, examination three of the above Royal Exhibitions to the Government School of Science will be open for competition independently of the prizes, &c., offered by the Science and Art Department.

All persons over 21 years of age, excepting artisans, and such as come within the category of persons paid upon under the Science Directory, will be excluded from competing for the Royal Exhibitions. Special cases, however, must be determined according to the spirit of the rules and the object of the endowment.

The competition for the Royal Exhibitions will be determined by affixing the following values to the several results of the May Examination, viz. :—

To a 1st grade Queen's Prize, in any subject, . . .	9 marks.
To a 2nd " " " . . .	7 "
To a 3rd " " " . . .	5 "
To an honorable mention, " . . .	3 "
To a pass, " . . .	1 "

And in addition—

For a gold medal, " . . .	10 "
For a silver medal, " . . .	7 "
For a bronze medal, " . . .	5 "

N.B.—All Candidates for Royal Exhibitions must have obtained at least a Third Class in Elementary Mathematics before they are eligible to obtain them.

Science Certificated Teachers may compete for the Royal Exhibitions. When coming up simply with this object they should inform the Science and Art Department, so that their names may not appear in the published list with the students.

FREE ADMISSIONS.

2. Free admissions to the lectures at the Government School of Science in Dublin are granted to any person who takes a gold medal in the May Examination.

PROGRAMME.

The systematic courses of scientific lectures delivered in the theatre of the Industrial Museum of Ireland, commencing with the Session of 1854–1855, may be considered as the first fully organized arrangement carried out in Dublin to provide those who are occupied in the day time with the means of employing their leisure hours in the evening in learning thoroughly the more practically useful branches of science. The success of the experiment, notwithstanding that the advantages offered could not at the outset have become generally known, has been such as to fully call for a continuation of it during the succeeding session.

But while the education of that numerous and important portion of the public will be provided for, it was proposed to extend still further the utility of those educational arrangements for the future, by establishing corresponding courses of lectures on the several departments of applied science, to be delivered during the day, and the arrangements adopted for that object have been found so successful, that they will be continued in the approaching Session, with only such slight modifications in detail as experience has proved to be desirable.

Day and Evening Classes.

In the session of 1866–1867, accordingly, there will be two distinct and independent series of courses of lectures—the one to be delivered in the daytime, the other in the evening. The number of lectures in each course will be found annexed.

Day Courses of Public Lectures.

Zoology.—Dr. Morgan will commence a course of six public lectures on Zoology, on Tuesday, 9th October, at four o'clock, P.M.

Geology.—Mr. Jukes will commence a course of six public lectures on Geology, on Tuesday, 30th October, at four o'clock, P.M.

Chemistry.—Dr. Sullivan will commence a course of six public lectures on Chemistry, on Tuesday, 13th November, at four o'clock, P.M.

Physics.—Dr. Barker will commence a course of six public lectures on Physical Science, on Tuesday, 27th November, at four o'clock, P.M.

Day Classes.

Practical Chemistry.—A course of Analytical and Practical Chemistry will be commenced by Mr. Galloway in the laboratory on Wednesday, the 10th October.

Evening Courses of Public Lectures.

Chemistry.—Dr. Sullivan will commence a course of twelve public lectures on Chemistry, on Wednesday, 10th October, at eight o'clock, P.M.

Geology.—Mr. Jukes will commence a course of twelve public lectures on Geology, on Monday, 12th November, at eight o'clock, P.M.

Physical Science.—Dr. Barker will commence a course of twelve public lectures on Physical Science, on Monday, 3rd December, at eight o'clock, P.M.

Zoology.—Dr. Morgan will commence a course of lectures on Wednesday, 2nd January, at eight o'clock, P.M., of which the first six will be public.

Botany.—Mr. Bradshaw will deliver a course of six public lectures on Economic Botany, *before* the Easter recess, on such days as shall be announced.

Practical Chemistry.—A course of twenty lessons on Practical Chemistry will be commenced by Mr. Galloway in the laboratory on Tuesday, February 5th, at seven, P.M. (The student is referred to the separate programme of laboratory arrangements for a more detailed account).

Systematic Educational Courses of Lectures.

Geology.—Mr. Jukes will commence a course of systematic educational lectures on Geology, on Tuesday, 11th December, at four o'clock, P.M.

Chemistry.—Dr. Sullivan will commence a course of systematic educational lectures on Chemistry, on Monday, 4th February, at four o'clock, P.M.

Physical Science.—Dr. Barker will commence a course of systematic educational lectures on Physical Science, on Monday, 1st April, at four o'clock, P.M.

Zoology.—Dr. Morgan will commence a course of systematic educational lectures on Zoology, on Wednesday, 2nd January, at eight o'clock, P.M.

Botany.—Mr. Bradshaw will commence a course of systematic educational lectures on Structural and Physiological Botany, immediately *after* the Easter recess; and, at its termination, another course on Systematic Botany, on such days as shall be announced.

During the period occupied by the latter course, and between its close and the examination of the class, the Professor of Botany intends to hold a series of excursions with the students, for practical field-instruction.

The session will commence on Monday, the 8th of October, 1866, and end on Wednesday, 19th June, 1867.

The Indian Telegraph Department now recognises the courses of lectures, as also the Practical Chemistry Classes connected with this Institution.

Registration and Fees.

No person will be considered eligible to compete for certificates or prizes unless he shall have registered himself as a student and paid the requisite fees.

The latest period for registration for attendance upon any course of instruction will be when one-third of such course shall have been delivered.

The office for registration of students is at the Industrial Museum, Stephen's-green, where Mr. G. C. Penny will receive the fees, enter the names of the students on the roll, and give cards of admission to the several courses, on every week day from eleven o'clock, A.M., to two o'clock, P.M., and on Monday evenings from seven to nine o'clock, P.M.

Students may register for one or more of the courses, and compete for the special certificates and prizes allotted to each course, but can only become eligible for a General Certificate by registration for and attendance upon a course in each of the four subjects, either in the day or evening classes.

A fee of 3*s*. 6*d*. will be charged for each of the systematic courses of lectures on Geology, Chemistry, and Physical Science; and 2*s*. for the lectures on Zoology or on Botany.

Examinations.

At the close of the courses of systematic lectures of each professor, an examination of the registered students will be held by the lecturer, and the names of those who pass it will be arranged and published in order of merit.

Students who have passed an examination, but not gained a prize, will be admitted to one more examination in the

same subject, after which they will not be deemed eligible for a prize in it.

Students who have once passed a General Examination will not be admitted to any further examination of any kind.

Certificates and Prizes.

Two kinds of certificates will be granted—

Pass Certificates will be given to such as pass each Special examination, whether Systematic or Practical.

General Certificates, stating the proficiency obtained in the several branches of study, signed by all the Professors, and countersigned by the Director, will be given to those who shall have passed all the Class Examinations within a space of two years.

The value of certificates testifying to a knowledge of the more practically useful branches of science will become daily more and more recognised: and already a very large number of the leading manufacturers of the United Kingdom have agreed to accept similar certificates as one of the highest testimonials which can be presented by persons seeking employment in their establishments. Every student should, therefore, strive to win such a certificate.

Prizes will be awarded to the first three names in the list of those who pass each examination, provided sufficient proficiency be shown.

These prizes will consist either of money, or of books stamped with the mark of the institution, or partly one and partly the other, at the option of the student.

The value of the prizes will be—

First prize, £5; second prize, £2; third prize, £1.

Practical Courses.

The sum of £8 will be awarded in prizes to the classes of Practical Chemistry, as will be arranged after the classes are formed.

No person having gained a Special prize will be deemed eligible again for a prize in the same subject.

The certificates will be awarded and the prizes conferred at a public meeting of the Institution, as will be arranged by the authorities of the Science and Art Department.

Evening Admission to the Galleries and Library of the Industrial Museum of Ireland.

Nothing tends so materially to familiarize the mind with scientific names, and to impress upon the memory the information acquired from books and lectures, as the examination

of the objects themselves, the study of whose properties or forms constitutes the basis of the experimental and observation sciences. This is especially true of natural history and geology, and, perhaps in an equal degree, of chemistry in its applications to industry. The collections illustrative of chemical compounds and chemical manufactures, and of geology, now in the galleries of the Industrial Museum of Ireland, are sufficiently extensive to be useful in this way. With a view, accordingly, of making them contribute as far as possible to public education generally, and especially to the development of the system of instruction established in the School of Arts and Manufactures, the galleries will be lighted with gas, and opened to the public on all the evenings of lecture during the session, and on such other evenings as shall be arranged, of which due public notice will be given.

With a view of facilitating the studies of those students who are occupied during the day, and cannot therefore visit any public library, access will be allowed to the library of the Industrial Museum of Ireland, which is provided with a number of suitable books in each department of science, selected by the respective professors. This library will be opened during the session at times and hours to be hereafter determined. The privilege of reading in this library must necessarily be exclusively confined to those students who desire to qualify for certificates by attendance upon all the courses, in one or other class, given during the session.

Recommendations to Students about their Preliminary Studies.

The best preparations for the study of any branch of science is the study of mathematics, not merely because it is itself the first of the fundamental sciences, and in some cases the most powerful and indispensable instrument of research, but even as a mere mental exercise. A familiarity with mathematical reasoning usually gives more definiteness and exactness of ideas, and leads the student to disregard the usual vague and loose statements which the untrained mind is apt to accept as science, while it teaches him to set most value in the experimental sciences upon numerical relations, not only as the most important in a theoretical point of view, but also in a practical one.

A knowledge of the four principal operations of arithmetic (addition, subtraction, multiplication, and division), vulgar and decimal fractions, the extraction of square and cube roots, ratio and proportion, and the elements of geometry, will enable a person to acquire a very good knowledge of experimental physics and chemistry. Without this amount

of knowledge, at least, many important points in both branches of science must be unintelligible, or at best must be very imperfectly understood.

And as it is impossible to have an accurate knowledge of animal and vegetable physiology, which are the basis of the other divisions of natural history, or of geology, without some previous knowledge of experimental physics and chemistry, this amount of elementary mathematics is equally necessary to the student who desires to pursue in an especial manner those branches of science.

There is one very simple truth which it is very desirable should be impressed upon the minds of students—namely, that in order to apply science to industry, it must be first learned; and that, consequently, the impression which commonly prevails, and which some, who ought not to do so, have helped to foster, that there is a kind of inferior science adapted for practical persons, is perfectly erroneous. Indeed, no one requires to know science so thoroughly as he who intends to apply it in his business. The kind of science which is capable of being applied to industry with advantage must therefore be, in reality, of a far higher character than what is required as an element of general education.

Persons who intend to register themselves as students of the School, with a view of applying the knowledge of science which they may acquire in some of the various branches of industry, such as mining, the construction of machines, textile and chemical manufactures, agriculture, &c., will do well to remember, that although the amount of mathematics mentioned above will enable them to acquire a vast amount of information in the subjects taught during the session, it will be far from sufficient to enable them to apply it with profit in industry. Such questions as the strength of materials; the flow of water, steam, or gas, through pipes; the construction of water-wheels and turbines; or the theory of machines in general, and similar questions which perpetually present themselves to the manufacturer, require for their solution a considerable amount of mathematical knowledge.

While it is to be hoped that no one will be discouraged from joining the classes of the ensuing session because they may not have previously studied the elementary mathematics, all who desire to acquire that accurate knowledge which alone is practically useful, should endeavour, either by self-instruction, or through the many facilities which exist for the purpose, to learn, at least, the most indispensable branches of elementary mathematics.

With a view of pointing out the extent of mathematics which it would be desirable that students who intend to

become mining engineers, ship-builders, machinists, or managers of factories generally, should possess, before commencing the study of the experimental sciences, and of guiding those who desire, in the mean time, or in future years, to reach this standard of preparation by self-instruction or otherwise, the following syllabus of a course of elementary mathematics is added. Such a course would take the student as far as the calculus, and would enable him to understand all lectures upon mechanics, statics, and dynamics, and make use of the generality of text books upon those subjects. Before entering upon the course of study the student would derive great advantage from the reading of some work on logic of the character of the "System of Logic," by J. S. Mill, or Thompson's "Laws of Thought."

SYLLABUS OF A COURSE OF ELEMENTARY MATHEMATICS, PREPARATORY TO THE STUDY OF THE PHYSICAL AND NATURAL SCIENCES, AND OF THEIR APPLICATION TO INDUSTRY.

Arithmetic.—Numeration and notation. *Integral Numbers:*—The four principal operations of arithmetic with whole numbers (addition, subtraction, multiplication, and division). Determination of the greatest common divisor of two or more numbers, and the simplest common multiple. *Fractions:*—1° *Vulgar Fractions*—Formation of vulgar fractions; the four principal operations with them. 2° *Decimal Fractions*—Distinction between vulgar and decimal fractions; the four principal operations with decimal fractions; conversion of vulgar fractions into decimal fractions, and the reverse.

Extraction of roots.

Ratio and proportion.

Geometry.—1° *Plane Geometry*—Properties of lines and angles. Properties of triangles and quadrilateral figures. Ratios and proportions. Geometry of the circle, and the measure of angles. Regular polygons, and the measure of the circle.

2° *Solid Geometry.*—Intersection of planes—solid angles. Solids bounded by planes:—The parallelopiped; polyhedrons. The three round bodies:—The cylinder, cone, and sphere. Properties of the sphere and spherical triangles.

Or the whole of Euclid's Elements of Geometry.

Elements of Geometrical Analysis.

Algebra.—The four rules with monomes and polynomes. Simple powers and roots. The greatest common measure, and the least common multiple. Fractions.

Equations of the first degree, including one unknown quantity. Equations of the first degree, including two or more unknown quantities.

Arithmetical progression. Geometrical progression. Permutations and combinations. Series and indeterminate coefficients. Binomial theorem.

Equations of the second degree. Exponential equations. Exponential and logarithmic series. Use of logarithms.

Classification of algebraical expressions and consequences. Relation between number and magnitude.

Trigonometry.—Definitions. Relations of trigonometrical lines. Relation between sines, cosines, &c., of sums, and differences of angles. Solution of plane triangles.

Elements of Analytical Geometry.—Application of algebra to the theory of Curves:—Straight lines; transformation of co-ordinates; lines of the second order, or the conic sections. Application of algebra to the theory of Surfaces:—The straight line in space. The plane. The sphere, cylinder, and cone. Surfaces of revolution. Surfaces of the second order.

Descriptive Geometry.—Projection of lines, of planes, and of curved surfaces. Intersections of lines, planes, and surfaces. Applications to cylindrical, conical, and spherical surfaces. Skew surfaces. Theory of ordinary perspective and of isometrical perspective. Theory of shadows.

R. K.

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Science and Art Department

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SYLLABUS OF THE LECTURES

ON

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TO BE DELIVERED BY

DR. W. BARKER.

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1866.

SYLLABUS.

PHYSICS.

Professor, William Barker, m.d.

Objects of Physical Science.—Definition of forces acting on Matter. Molecular and Physical forces—Ponderable and imponderable substances.

PROPERTIES OF PONDERABLE MATTER.

Physics of Ponderable Matter.—General properties of Matter — Extension — Divisibility — Mathematical proof of Infinite Divisibility—Practical limits—Illustrations of extreme Divisibility afforded by Chemistry and by Mechanical and other means—Impenetrability—Porosity—Compressibility—Elasticity—Relative Elasticity of different forms of Matter—Tenacity — Measures of Cohesive Force — Importance of knowledge of force of Cohesive Attraction in the Arts — Adhesion—Capillary Attraction—Endosmose and Exosmose —Gravity — Its action on Matter of all Forms — Specific Gravity—Inertia—Laws of Inertia—Special properties of Matter—Elasticity and Hardness—Ductility—Malleability.

STATICS.

Forces exerted on Matter.—Force produces rest or motion or change of direction, on Matter in motion—Limit of force—Measurable and Immeasurable forces—Measurable forces, how expressed in quantity and direction—Composition and Resolution of Forces—Resultant of two or more forces —How expressed in quantity and direction—Parallelogram of forces—Polygon of forces—Parallel forces—Centre of Gravity—determination of its position in lines, symmetrical figures, surfaces and solids—Equilibrium—Stable or unstable.

DYNAMICS.

Forces of Matter in Motion.—Composition and Resolution of Motion—Motion absolute or relative—Resultant of two or more Motions—Curvilinear Motion—Momentum—Forces derived from Momentum—Formulæ expressive of Momentum—Application to Machinery—Laws of Action and Reaction—Effects of Collision—Effects on elastic and inelastic Matter—Centrifugal force—Consequence of Inertia—Whirling Table—Application of Centrifugal force to manufactures.

Effects of Gravity in producing motion—Motion, uniform or accelerated—Accelerated velocity—Attwood's Machine for proving laws of accelerated motion—Formulæ for expressing relations of Space, Time, and Velocity—Motion of bodies down an Inclined Plane—Motion in a Cycloidal Arc—Pendulum—Compensating Pendulum.

Theory of Machinery.—Motive powers used in Machinery, or Prime Movers—Primary sources of Motive Power—Machines do not increase power, merely alter time or direction of its application.

Simple Machines.—Lever, three species of—Conditions of Equilibrium in three species—Inclined Plane—Pulley—Balance—Wheel and Axle—Wheelwork—Screw—Hunter's Screw—Wedge—Pulleys—Compound Pulleys—Angular divergence of Cords.

Friction and Rigidity.—Different kinds of friction—Laws of friction—Friction in Lever—Inclined Plane and Wedge—Pivot friction—Friction of rolling bodies—Rigidity of Ropes and Chains.

Strength of Materials.—Dependent on forces resisting tension, pressure, or torsion—How ascertained by direct experiment—Relative strength of solids of different species—Relative strength of different forms of same material.

HYDROSTATICS AND HYDRODYNAMICS.

Properties of Liquids.—Mobility of Particles—Elasticity—Compressibility of Water—Œrsted's Experiments—Importance to the conditions of life the slight compressibility of Water—Liquid Pressure—Pressure of Liquids in every

direction—Hydrostatic Paradox—Bramah's Press—Calculation of Power produced by—Application to raising Weights or to Compression—Pressure of Water at various depths—Calculation of Pressure—Important physical effects on Earth's surface dependant on Pressure—Importance of a knowledge of laws of Liquid Pressure in the construction of Walls, Embankments, &c.

Upward and Lateral Pressure.—Pressure as depth—Pressure on sides of Vessels—Examples of Pressure—Practical applications—Effects of immersion of Solids in Liquids—Loss of weight by immersion—Specific Gravity explained—Specific Gravity of Liquids and Gases—Specific Gravity of Solids ascertained by Hydrostatic Pressure—Specific Gravity of Liquids ascertained by pressure on Solid—Important applications of different Specific Gravities of solids and liquids.

Motion of Liquids.—Liquids obey laws of Inertia—Momentum of Liquids in Motion—Velocity of Efflux—Vena Contracta—Application to produce Motion in Machinery—Method of calculating Power produced by falling Water—Water Engines—Water Wheels—Reaction Wheels—Whitelaw's Mill—Turbines—Machines for raising Water—Centrifugal Pumps, different forms of—Archimedes' Screw.

PNEUMATICS.

Apparatus used in Researches on Properties of Air.—Air-pumps—Syringe—Condenser—Undulation produced in Liquids.

General Properties of Gases.—Elasticity—Density—Marriotte's Law—Weight—Atmospheric Pressure—Barometer, various forms of—Aneroid Barometer—Height of Atmosphere—Atmospheric Waves—Diurnal variation of Barometer—Method of measuring heights of Mountains by Barometer—Barometer employed as indicator of Weather—Fallacy of popular ideas of its utility.

Illustrations of Atmospheric Pressure and Elasticity, and their Applications in the Arts and to Machinery.—Lift Pump—Force Pump—Fire Engine—Hero's Engine—Atmospheric Engine.—Adaptation of Pneumatic Laws to conditions of Earth's surface—Varying density of Atmosphere—Laws of Diffusion—Alterations from Heat—Bad conducting Power—Specific Heat of—Changes produced by respiration of Plants and Animals—Physical Laws adapting Atmosphere to Animal Life—Ventilation of Buildings.

ACOUSTICS.

Sound.—Its mode of Propagation—Intensity of Sound—Velocity in Gases, Liquids, and Solids—Reflexion and Refraction of Sound—Echo and Resonnance—Interference of Sonorous Waves.

Vibration of Cords—Illustrated by Monochord—Rates of Vibration of Musical Notes—Cause of Harmony of Sounds—Harmonic Vibrations—Absolute number of Vibrations, how determined—The Sirene—Savart's Wheel—Vibrations of Air in Pipes—Of Rods and Plates—Nodal Points.

HEAT.

Heat.—Theories of—Material Hypothesis, objections to it—Dynamical Theory—Heat supposed to arise from Motion of Ultimate Particles of Matter—Mechanical equivalent of Heat—Joule's Experiments—Sources of Heat—Description of Instruments used in Investigations—Thermometers—Thermo-electric Pile—Galvanometer—Effects on Matter—Importance of knowledge of its effects in the Arts.

Expansion by Heat of Solids, Liquids.—Coefficient of expansion—Linear and Cubical Expansion, how determined—Method of Laplace—Force of dilatation and contraction in Solids by changes of temperature—Importance of knowledge of laws of dilatation of Solids in Arts of Construction—Relative dilatation of different classes of Solids—Application to construction of Standards of Length—Pendulums. Measures of Heat. Mechanical equivalent of Heat. Expansion of Liquids—Coefficient of expansion in different Liquids—Exception to Laws of Expansion—Changes dependant on conversion of Solids into Liquids or Vapours, and Liquids or Vapours into Solids.

Thermometers.—Principle of Thermometer—Liquids employed in its Construction—Mode of Graduation—Scale adopted in different Countries—Fahrenheit—Reaumur—Centigrade—Rules for reducing Temperature of one Scale to that of another—Sources of Error in use of Thermometers—Breguet's Thermometer—Pyrometers,—Wedgwood's—Daniel's—Exceptions to Law of Dilatation—Apparent exceptions.

Expansion of Gases by Heat.—Expansion by Constant Increments—Coefficient of Expansion of Gases—Conduction

and Convection in Gases—Physical Changes on Earth's Surface due to Convection—Winds caused by Solar Heat—Atmospheric Currents—Trade Winds—Monsoons, &c., &c.

Conduction of Heat.—Depends on transmission of Motion—Conducting Power different in Bodies—Difference in Solids, Liquids, and Gases. Conduction of Cold—Influence of Mechanical Condition on Conducting Power—Conduction in Gases.

Specific Heat.—Methods of determining Specific Heat—Calorimeter—Equalization of Temperature—Cooling of Bodies—Natural Phenomena dependent on different Specific Heat of Bodies.

Latent Heat.—Absorption of Heat by solution—Evolution by crystallization—Congelation—Latent Heat of Vapours—Ebullition—Causes producing Change of Boiling Point—Elastic Force of Vapours—Application of these Laws to the principles of the Steam Engine.

Early History of Steam Engine.—First Engine devised by Hero of Alexandria—Inventions of Garay—De Caus—Branca—Marquess of Worcester—Morland—Papin—Savary—Newcomen—Watt.

Parts of Engine.—Boiler—Gauges—Feeding Apparatus—Cylinder—Piston—Crank—Valves—Spindle Valve—D Valve—Sliding Valve—Fourway Cock—Fly Wheel—Governor.

Radiation and Reflection of Heat.—Laws of Radiation—Causes modifying Radiation—Reflection of Heat from plane surfaces—Reflection from curved surfaces—Apparent reflection of Cold—Reflective power of different surfaces.

Diathermancy.—Diathermal properties of different substances—Experiments of Melloni—Theory respecting the different species of calorific rays. Actinism.

ELECTRICITY.

Electricity.—Early History of Electricity. Facts observed by Thales, Theophrastus, Pliny, &c. Sources of Electricity. Friction. Change of Form. Change of Temperature Chemical Action. Contact or Pressure. Vital Action. Induction. Magnetic Induction. Theories of Dufay, Franklin,

Eales, Cavendish, and Faraday. Different species of Electricity. Vitreous or Positive, Resinous or Negative.

Classification of Bodies with respect to their Electric Properties.—Conductors, Non-Conductors, Electrics, Non-Electrics. Defects of this Division of Bodies. Electricity of Friction produced in Idio-Electric Bodies. Classification of Bodies in reference to Conducting Power. Effects of Physical Changes in altering Electric Properties of Bodies. Insulation.

Induction.—Laws of Electrical Action on distant objects. Faraday's Theory. Electrical Attractions and Repulsions.

Apparatus employed in Electric Experiments.—Electroscopes. Condensers. Electrifying Machine. Its Action, according to Theories of Dufay and Franklin. Leyden Jar. Theory of the Leyden Jar. Unit Jar. Electrometers. Electrophorus of Volta. Distribution of Electricity in Bodies. State of Charge in Electrics. Tension, Intensity, and Quantity.

Effects of Electricity.—Mechanical Effects. Discharge through Non-Conductors and Conductors. Different Forms of Discharge. Luminous Effects. Source of Light in Discharge. Production of Ozone. Chemical Decompositions. Heat of Discharge. Magnetic Phenomena.

Atmospheric Electricity.—Thunder-storms. Lightning Conductors. Importance of knowledge of Electrical Laws in Arts of Construction. Personal Danger during Thunderstorms, how best avoided. Protection of Ships by Conductors. Comparative immunity at the present, compared with former times. Aurora Borealis. Meteors. Waterspouts.

Dynamical Electricity.—Identity of two Species of Electricity. Sources of Electricity in Motion. Discoveries of Galvani and Volta. Contact Theory of Volta. Proof by Faraday of Electromotive Force not depending on Contact. Voltaic Battery, its various Forms. Groves' Battery. Phenomena caused by. Heat and Light. Theories respecting Origin of Electromotive Force. Practical Applications. Electrolysis.

Electrotyping.—History of this Art. Application to copying Forms in different Metals. Matrices. Different kinds Electroplating. Best Methods of producing Silver Deposit. Materials employed. Electrogilding. Value and importance of this Application of Electricity in Manufactures and the Fine Arts.

Magnetism.—General Phenomena. Methods of communicating Magnetism. Magnetic Induction. Substances capable of Magnetic Induction. Effects of Heat on Magnetism. Terrestrial Magnetism. Mariner's Compass. Declination. Magnetic Meridians. Diurnal Variation. Periodical Variation. Diamagnetic Properties of Matter.

Electro-Magnetism.—Laws of Electro-Magnetic Induction. Rotation of Currents. Magnetic Electricity. Practical Applications. Motive Power produced by Electro-Magnetism. Electricity applied to Telegraphic Purposes. Velocity of Transmission of Electric Currents.

Electric Telegraph.—Its early History. Statical Electricity first employed. Objections to its use. Submarine Telegraph. Difficulties arising from Induction. American Cable. Electro-Magnetic Force. Its Applications. Chemical Decomposition. Various Forms of Printing Telegraph. Regulation of Time by Electric Telegraph. Electric Clocks.

OPTICS.

Light.—Laws of Propagation—Velocity—Theories respecting its Cause—Refraction of Light—Snellius' Law of Sines—Lenses—Formation of Images by Lenses—Reflection of Light—Reflection from Plane Surfaces—Reflection from Curved Surfaces—Images formed by Reflection—Laws of Vision—Structure of the Eye—Optical Instruments—Reflecting and Refracting Telescopes—Microscopes—Camera.

Chromatic Phænomena.—Decomposition of Light by Prism—Recomposition of White Light—Complementary Colours—Chemical and Calorific Properties of Spectrum—Epipolic Dispersion—Diffraction of Light—Colours of Thin Plates.

Polarized Light.—Double Refraction—Undulatory Theory—Plane Polarized Light—Modes of Polarizing Light—Polariscopes—By Refraction—By Reflection—By Absorption—Colours exhibited by Polarized Light.—Application of Polarized Light in the Arts.

Text-books recommended Lardner's Handbook of Natural Philosophy; Ganot, Cours de Physique; Bird's Natural Philosophy.

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SYLLABUS.

CHEMISTRY.

Professor, William K. Sullivan, Ph.D.

GENERALITIES.

Divisibility of matter. Different physical states which matter can assume. Cohesion. Dissolution. Combination and decomposition. Matter is apparently of different kinds; these different kinds of matter are called simple bodies, or simple radicles. All bodies are either simple or compound. Certain compound bodies can perform the functions of simple bodies; such bodies are called compound radicles. Simple and compound bodies which combine with each other have opposite properties, some performing chlorous functions, and others basylous.

Compound bodies have a constant definite composition. Two simple bodies may unite in several proportions by weight; the numbers representing these proportions bear a very simple relation to one another. The numbers representing the simplest proportions in which the simple bodies combine are called proportional numbers.* Symbolic notation,—symbols, formulæ, equations.

Relation between proportional numbers and the specific gravity of the vapours of simple and compound bodies,—law of combination by volume. Distinction of atom and molecule. Relation of gases to temperature and pressure. All combination consists in a substitution of atoms; double decomposition; the quantity of each substance which takes part in a substitution is different,—law of equivalent substitution. Atomicity of the different simple bodies.

Molecular types, or types of double decomposition,—hydrogen type, chlorhydric acid type, water type, ammonia type; mixed types. Classes of compounds: acids, hydrous bases; anhydrides, which may be derived from acids, or anhydrides proper, from hydrous bases, or anhydrous oxides,

* In the formulæ in this Syllabus the equivalent of oxygen is considered to be 16; sulphur, 32; selenium, 80; tellurium, 128; carbon, 12; silicon, 28·5.

sulphides, &c., or from both, or salts; acid and basic salts; derivative acids and bases; atomicity of acids and bases; aldehyds, derivatives of aldehyds; amides. Relations of the bodies of each class, and of the different classes with each other; heterologous, homologous and isologous series.

Crystallization; classification of crystalline forms. Isomorphism, polymorphism. Allotropy; isomerism. Atomic or specific volume. Atomic or specific heat.

NOMENCLATURE AND CLASSIFICATION.

A nomenclature merely expresses the theoretical views of its framer; it must therefore undergo modification, or be wholly changed as the science progresses. The distinction of positively and negatively electrified bodies remains, to a certain extent, the basis of the existing nomenclature. Explanation of the names of simple and compound radicals. Etymological principles upon which the names of chemical compounds are formed.

All classifications of simple bodies must be more or less artificial. Different ways in which we may classify the simple bodies, according to the point of view from which we may desire to study them. The classification which best brings together those bodies having analogous chemical functions, and similar atomic equivalency, may be called the natural classification. In the present state of science all attempts to establish such a classification must necessarily be imperfect. The following table contains the names of all the simple radicles with their symbols and atomic weights, classified according to their relationships and most characteristic atomicities:—

Group I.—Hydrogen (H′, 1).

" II.—Halogen Group: Chlorine (Cl′, 35·5), Bromine (Br′, 80), Iodine (I′, 127); Fluorine (F′, 19).

" III.—Amphigen Group: Oxygen (O″, 16), Sulphur (S″, 32), Selenium (Se″, 80), Tellurium (T″, 128).

" IV.—Nitrogen (N‴, 14), Phosphorus (P‴, 31), Arsenic (As‴, 75), Antimony (*Stibium*, Sb‴, 122), Bismuth (Bi‴, 210).

" V.—Carbon (C⁗, 12), Silicon (Si⁗, 28), Titanium (Ti⁗, 48), Tantalum (Ta⁗, 138), Niobium (Nb—), Zirconium (Zr⁗, 89·5), Thorinum (Th⁗, 231), Tin (*Stannum*, St⁗, 118), Lead (*Plumbum*, Pb, 103·5, or Pb⁗, 207); Boron (B, 11?).

Group VI.—Lithium (Li', 7), Sodium (*Natrium*, Na', 23), Potassium (*Kalium*, K', 39), Rubidium (Rb', 85), Cæsium (Cs', 133), Silver (*Argentum*, Ag', 108).

„ VII.—Calcium (Ca', 20, or Ca'', 40), Strontium (Sr', 44, or Sr'', 87·5), Barium (Ba', 68·5, or Ba'', 137), Glucinum (G', 4·7, or G'', 9), Magnesium (Mg', 12, or Mg'', 24), Zinc (Zn', 32·5, or Zn'', 65), Cadmium (Cd', 56, or Cd'', 112), Mercury (*Hydrargyrum*, Hg', 100, or Hg'', 200).

[Yttrium (Y, 32 or 64), Cerium (Ce, 46 or 92), Lanthanum (La, 46 or 92), Didymium (Di, 48 or 96), Erbium and Terbium (the atomic weights of the latter two are unknown), may perhaps belong to this group.]

„ VIII.—Rhodium (Ro, 52 or 104), Iridium (Ir, 98·5, or 197), Palladium (Pd, 53 or 106·5), Platinum (Pt, 98·5 or 197), Ruthenium (Ru, 52 or 104), Osmium (Os, 99·5 or 199).

„ IX.—The Iron metals: Iron (*Ferrum*, Fe', 28, or Fe'', 56), Nickel (Ni', 29·5, or Ni'', 59), Copper (*Cuprum*, Cu', 31·75, or Cu'', 63·5, Mn', 27·5, or Mn'', 55). Cobalt (Co', 29·5, or Co'', 59), Chromium (Cr', 26·25, or Cr'', 52·5), Vanadium (Va, 68·5, or Va'', 137), Uranium (U, 60, or U'', 120).

„ X.—Aluminium (Al''', 27·5), Thallium (Tl''', 203), Gold (*Aurum*, Au''', 196).

„ XI.—Molybdenum (Mo''', 48, or Mo^{vi}, 96), Tungsten (*Wolfram*, W''', 92, or W^{vi}, 184).

[The atomic weight and properties of the new metal Indium are as yet unknown.]

DESCRIPTION OF EACH GROUP.

GROUP I.

Sources, preparation, physical and chemical properties, and substitutions of hydrogen.

GROUP II.

Sources, preparation, physical and chemical properties, and substitutions of each member of the Halogen group.

Combinations with Hydrogen.

Preparation and properties of the compounds of the bodies of the Halogen group with hydrogen,—chlorhydric, bromhydric, iodhydric and fluorhydric acids. Classification, properties and preparation of chlorides, bromides, iodides, and fluorides.

Oxidized Compounds.

Preparation and properties of the oxidized compounds of chlorine, bromine, and iodine; hypochlorous anhydride and acid, hypochlorites; chlorous anhydride and acid, chlorites; chloric anhydride and acid, chlorates; perchloric acid, perchlorates; perchloric oxide, &c. Hypobromous acid and hypobromites; bromic acid and bromates. Iodic acid and anhydride, iodates; periodic anhydride and acid, periodates.

Combinations of the Halogens with each other.

Chloride of bromine; chlorides and bromides of iodine.

GROUP III.

Sources, preparation, physical and chemical properties, and substitutions of oxygen, sulphur, selenium, and tellurium.

Combinations with Hydrogen.

Water. Different circumstances under which oxygen and hydrogen gases combine. Physical properties of water in different states; freezing and boiling of water; spheroidal condition. Chemical functions of water—water of crystallization. Solution of bodies. Absorption of gases by water. Natural waters; their purification. Analytic methods employed to establish the composition of water. Synthesis of water; eudiometers. Preparation and properties of deutoxide of hydrogen, or oxygenated water. Classification, properties and preparation of hydrous and anhydrous oxides. Preparation and properties of sulphide and bisulphide of hydrogen, selenide of hydrogen, and telluride of hydrogen. Hydrous and anhydrous sulphides, selenides, and tellurides.

Combinations with the Halogens.

Chlorides, bromides, and iodides of sulphur, selenium, and tellurium.

Oxidized Compounds.

Sulphur.—Preparation and properties of: sulphurous chloraldehyd, anhydride and acid, sulphites; sulphuric chlor-aldehyd, anhydride and acid, sulphates;—classification of sulphates. action of heat upon acid sulphates, pyrosulphuric or Nordhausen acid and its salts; thiosulphuric acid, and thiosulphates or hyposulphites; polythionic acids, and their salts.

Selenium and Tellurium.—Preparation and properties of: oxide of selenium; selenious acid and anhydride, selenites; selenic acid and anhydride, seleniates; tellurous anhydride and acid, tellurites; telluric anhydride and acid, tellurates.

Combinations with Sulphur.

Sulphides of selenium and tellurium.

Summary.

General considerations on the group. The water type.

Group IV.

Sources, preparation, physical and chemical properties, and substitutions of nitrogen, phosphorus, arsenic, antimony and bismuth.

Combinations with Hydrogen.

Preparation and properties of the compounds of nitrogen, phosphorus, arsenic, and antimony with hydrogen—ammonia or amine; phosphoretted hydrogen or phosphine, liquid and solid phosphides of hydrogen; arsenetted hydrogen or arsine, solid arsenide of hydrogen, arsenides; antimonetted hydrogen or stibine, antimonides. Theory of ammonium; ammoniacal salts. Phosphonium, arsonium, stibonium. Derivatives of ammonia. Action of heat and of dehydrating substances, on the ammoniacal salts of monobasic, bibasic, and tribasic oxacids—monamides, diamides, triamides, amic acids and their salts.

Combinations with the Halogens.

Combinations of nitrogen, phosphorus, arsenic, antimony and bismuth with the halogens—chlorides, bromides, iodides, and fluorides of nitrogen, phosphorus, arsenic, antimony, and bismuth.

Oxidized Compounds.

Nitrogen.—Preparation and properties of: nitrous and nitric oxides; chloride of azotyl, nitrous anhydride and acid, nitrites; pernitric oxide; chloride of nitryl, nitric anhydride and acid, nitrates—ortho- and meta- nitrates.

Atmospheric Air. Qualitative analysis of air. Experiment of Lavoisier. Processes employed for the analysis of air. Composition of the atmosphere. Diffusion of gases. Proofs that air is a mixture and not a compound. Physical properties of atmospheric air. Functions of the atmosphere.

Phosphorus.—Preparation and properties of: Hypophosphorus acid, hypophosphites; phosphorous anhydride and acid, phosphites; phosphoric chloraldehyd, or oxichloride of phosphorus, sulphochloride of phosphorus, phosphoric anhydride, orthophosphoric acid, orthophosphates; action of heat upon orthophosphoric acid and acid orthophosphates,—meta- and para- phosphoric acids and their salts.

Arsenic.—Preparation and properties of: arsenious anhydride and acid, arsenites; arsenic anhydride and ortharsenic acid, arsenates, meta- and par- arsenates.

Antimony.—Preparation and properties of: anhydrous teroxide of antimony, meta- antimonious hydrate; tetroxide of antimony; antimonic anhydride or pentoxide of antimony, orthantimonic, metantimonic and parantimonic acids, and their salts. Salts of antimonyl and of antimony.

Bismuth.—Preparation and properties of: bismuthous oxide or teroxide of bismuth, bismuthous hydrate; bismuthic anhydride, or pentoxide of bismuth, bismuthic acid. Salts of bismuth and bismuthyl.

Combinations with Sulphur, &c.

Sulphides of nitrogen, phosphorus, arsenic, antimony, and bismuth.

Combinations of Nitrogen with the other Members of the Family.

Monophosphamide, phosphodiamide, phosphotriamide, phosphamic acid, &c.

Summary.

General considerations on the group. The ammonia type.

GROUP V.

Sources, preparation, physical and chemical properties, and substitutions of carbon, silicon, titanium, tin, lead, &c.; and boron.

Combinations with Hydrogen.

Carbides of hydrogen; general properties of those compounds. Isomerism of carbides of hydrogen. Classification of carbides of hydrogen into homologous and isologous series; tabular representation of all possible carbides of hydrogen. Summary of all known homologous series: 1, homologues of free methyl $(C_m H_{2m+1})^2$, or the free alcohol radicles; 2, homologues of marsh gas $C_m H_{2m+2}$, or hydrides of alcohol radicals; 3, olefines or homologues of ethylene $C_m H_{2m}$; 4, homologues of acetylene $C_m H_{2m-2}$; 5, oil of turpentine group, and its isomeres $C_m H_{2m-4}$; 6, Benzene series $C_m H_{2m-6}$;

7, cinamene and its homologues $C_m H_{2m-8}$; 8, naphthalene and its homologues $C_m H_{2m-12}$; 9, stilbene series $C_m H_{2m-16}$.

Carbides of hydrogen may be looked upon as the molecules of compound basylous radicles, of which there are as many derivable from each as it has atoms of hydrogen.

Derivatives by substitution from carbides of hydrogen,—action of chlorine, bromine, &c., upon carbides of hydrogen.

Combinations of the Carbo-Hydrogen Radicles with Simple Basylous or Metallic Radicles.—Zincomethyl and zincethyl; natri- and kali- ethyl; compounds of ethyl and methyl with magnesium and aluminium; stannomethyls and stanethyls; plumbomethyls and plumbethyls; mercurosi- and mercurimethyl, mercurosethyl and mercurethyl; arsenmonomethyl, arsendimethyl (kakodyl), arsentrimethyl, arsentetramethyl, corresponding compounds of arsenic with ethyl; stibmethyl and stibethyl, stibmethylium, and stibethylium; bismuthethyl and bismuthtriethyl, and the corresponding compounds of methyl. These bodies show that in all the combinations of the simple bodies the conditions of stable equilibrium are best fulfilled by certain molecular groups. Influence which the study of this class of bodies is likely to exert on our notions regarding simple and compound radicles.

Silicides of hydrogen.

Compounds with the Halogens.

Carbon.—Chlorides, bromides, &c., of carbon; chlorides of carbo-hydrogen radicles. Halogen ethers.

Chlorides, Bromides, &c., of Silicon, Titanium, Tin, and Lead; and Boron.

Combinations with Oxygen, Sulphur, &c.

Carbon.

Preparation and properties of protoxide of carbon; carbonic anhydride, carbonates; protosulphide and bisulphide of carbon, sulphocarbonates.

OXYGEN, SULPHUR, SELENIUM, AND TELLURIUM, DERIVATIVES OF CARBIDES OF HYDROGEN, OR BODIES FORMED ON THE WATER TYPE.

A. *Basylous Division.*

a. HYDROUS BASYLOUS OXIDES.

Alcoholides. Preparation and properties of common alcohol; this substance is a type of a numerous class of bodies ana-

logous to the hydrous basylous oxides of the metals. Classification of the class of alcoholides according to their atomicity or the number of displaceable hydrogen atoms which they contain.

I. *Monatomic Alcohols*, or alcohols which form but one ether with monatomic acids: 1. Alcohols homologous with vinic or common alcohol—methylic, propylic, amylic, and other alcohols, represented by the general formula $C_mH_{2m+2}O$, in which the homologous radicles $C_mH_{2m+1}{}'$ are assumed; 2. Alcohols of the formula $C_mH_{2m}O$, in which the radicles $C_mH_{2m-1}{}'$ are assumed, or the allylic series; 3. Alcohols of the formula $C_mH_{2m-2}O$, in which the radicles $C_mH_{2m-3}{}'$ are assumed; 4. Alcohols of the formula $C_mH_{2m-6}O$, in which the radicles $C_mH_{2m-7}{}'$ are assumed; or the benzoic series, and the isomeric series, represented by phenylic alcohol and its homologues. The more important derivatives of methylic and ethylic alcohols as types of monatomic alcohol derivatives generally.

Monatomic sulphur alcohols.

II. *Biatomic Alcohols*, or Glycols, or alcohols which can form two ethers with a monatomic acid: 1. Glycols homologous with common glycol, and represented by the general formula $C_mH_{2m+2}O_2$, in which the radicles $C_mH_{2m}{}''$ are assumed; 2. Glycols represented by the formula $C_mH_{2m-6}O_2$, in which the radicles $C_mH_{2m-8}{}''$ are assumed, and related to the benzoic monatomic alcohol series.

III. *Triatomic Alcohols*, or alcohols which can form three ethers with a monatomic acid. Glycerine or hydrate of the triatomic radicle glyceryl $C_3H_5{}'''$.

Triatomic Sulphur alcohols—mono-, di-, and trithioglycerin.

IV. *Higher Polyatomic Alcohols.*—Glucoses, most of which are probably hexatomic alcohols: 1. Glucoses proper, of which some deviate the plane of polarization to the right (grape sugar, starch sugar, diabetic sugar, maltose, &c.), and others to the left (left-handed fruit sugar, the left-handed glucose derivable from cane sugar by the action of acids, &c.): 2. Saccharine bodies isomeric with true glucoses, but not fermentescible (sorbine eucalyne, inosite, &c.); 3. Saccharine bodies which do not ferment, and which contain proportionally less oxygen than the bodies belonging to the groups 1 and 2 (mannite, dulcite, phycite, quercite, pinite, &c.)

Multiple or Polyradical Alcohols.—Normal or orthohydrates of polyatomic radicles may, by the loss of the elements

of water, or by fixing upon themselves the elements of one or more molecules of the oxide of their radicles, give rise to a new class of hydrates of great importance. Hydrates derivable from Biatomic Radicles: polyethylenic alcohols. Hydrates derivable from Triatomic Radicles: polyglycerines; glycide and polyglycides; Hydrates derivable from Hexatomic Radicles: mannitan, &c. Many vegetable substances appear to belong to this class of bodies, among which the following are especially important:—

Cellulose.—Proximate principles of wood; paracellulose, or the matter of the cellular or utricular tissue; fibrose, or the matter of the fibrous tissue; and vasculose, or the matter of the vessels proper.

Starch.—Different kinds of starch; inuline, lichen starch, &c. Action of heat in the presence of water upon starch; dextrine—different kinds of dextrine.

Gums.—Gummic and metagummic acids; nature of arabine and cerasine; bassorine. Pectose and the gelatinous principles of fruits derived from it.

Analogy which those bodies present to meta- and paraphosphoric, arsenic, &c., acids.

b. AMPHIGEN ETHERS INCLUDING THE ANHYDRIDES, OR ANHYDROUS OXIDES, SULPHIDES, SELENIDES, AND TELLURIDES OF CARBO-HYDROGEN BASYLOUS RADICLES.

α. Simple Ethers.—Action of acids upon alcohol—sulphovinic acid; theory of the production of common ether. Sulphide selenide and telluride of ethyl. Simple amphigenic ethers of monatomic alcohols; simple amphigenic ethers of biatomic alcohols; simple amphigenic ethers of triatomic and higher polyatomic acids.

β. Conjugate Ethers.—Or ethers containing two or more different basylous radicles.

Mixed Ethers of the Monatomic Alcohols.—Important influence which the discovery of this class of bodies has had upon our knowledge of the true constitution of alcohols and ethers.

Mixed Ethers of Biatomic Alcohols.

Mixed Ethers of Triatomic Alcohols.—Ethylin, diethylin, triethylin, ethylamylin, triethyl-diglycerin, tetrethyl-triglycerin, &c.

Simple and Mixed Ethers of the higher Polyatomic Alcohols.

Simple and Mixed Ethers derived from Multiple or Poly-

radical Alcohols.—Polyethylenic, and polyglyceric ethers, mannitanides, &c. Many vegetable bodies appear to belong to this class, such as the following:—

Compound Sugars.—Cane sugar, lactose or milk sugar, melitose, mycose, trehalose, &c.

Glucosides which yield glucose and neutral non-nitrogenous bodies.

Non-nitrogenous colouring and neutral vegetable substances which perhaps belong to this class of bodies.

γ. *Compound Ethers or Salts.*—That is, compounds containing both chlorous and basylous radicles.

Compound ethers of monatomic alcohols with monatomic acids—description of the more important ethers of this group, spermaceti, waxes, &c.; with polyatomic acids—acid ethers or vinic acids.

Compound ethers of biatomic alcohols with monatomic and polyatomic acids: ethylenates.

Compound ethers of triatomic alcohols: glycerides, or oils and fats. Glycerides of monatomic, biatomic, and triatomic acids. Process of saponification. Summary of the more important glycerides that form animal and vegetable oils and fats: acetines, butyrines, valerines, laurostearines, myristines, palmitines, margarines, oleines, &c.

Compound Ethers of higher Polyatomic Alcohols and of Multiple or Polyradical Alcohols.—Glucosides which break up into glucoses and acids—tannins, populin, amygdalin, myronate of potassium, cork, &c. To this class also belong many glucosides which contain nitrogen, and which contain apparently ammonia derivatives, and may therefore be considered as formed by the union of bodies belonging to the water and ammonia types, such as cutine, lycopodium, gelatine, and chondrine, white chyle globules, hæmatine derived from the white chyle, and the colouring matter of the bile formed from hæmatin, the white substance which, under the influence of light, produces chlorophyl in plants, and chlorophyl itself, albumenoid bodies (fibrin, albumen, vitellin, casein, gluten, legumin, amandin, &c.)

B. *Chlorous Division.*

Derivatives of basylous compound radicles by substitution of oxygen, &c., for part of the hydrogen, or chlorous compound radicles—

a. HYDRIDES OF CHLOROUS COMPOUND RADICLES OR ALDEHYDS.

Preparation and properties of common aldehyd; relation of common aldehyd to alcohol. Chloraldehyds. Homelo-

gous series of monatomic aldehyds known at present: aldehyds of the formula $C_mH_{2m}O$ derivable from the vinic alcohol series, and in which the radicles $C_mH_{2m-1}O'$ are assumed; 2. Aldehyds of the formula $C_mH_{2m-2}O$, derivable from the allylic alcohol series, and in which the radicles $C_mH_{2m-3}O'$ are assumed; 3. Aldehyds of the formula $C_mH_{2m-8}O$ derivable from the benzoic alcohol series, and in which the radicles $C_mH_{2m-9}O'$ are assumed.

Properties of acetone; relation between acetone and aldehyd; acetone the type of a class of derivatives called KETONES.

b. ACIDS, OR HYDROUS COMPOUNDS OF CHLOROUS RADICLES.

I. Monatomic Acids.

α. Monatomic Acids derivable by Oxidation from Monatomic Alcohols.—1. Acids of the formula $C_mH_{2m}O_2$, derivable from vinic alcohol and its homologues—formic, acetic, propylic, butyric, &c., acids. 2. Acids of the formula $C_mH_{2m-2}O_2$, derivable from the alcohols $C_mH_{2m}O$,—acrylic, angelic, oleic, &c., acids. 3. Acids of the formula $C_mH_{2m-4}O_2$ corresponding to the alcohol series $C_mH_{2m-2}O$,—sorbic and parasorbic acids. 4. Acids of the formula $C_mH_{2m-8}O_2$, derivable from the benzoic alcohol series $C_mH_{2m-6}O$, the aromatic acids—benzoic toluylic, &c., acids and their homologues.

β. Monatomic Acids, whose relations with alcohol series have not yet been established, exclusive of amic acids, which will be treated of hereafter; brief description of some of the more important acids of this class.

II.—Biatomic Acids.

α. Biatomic Acids related to Biatomic Alcohols:—

a. Monobasic or Aldehydic Acids.—1. Acids of the formula $C_mH_{2m}O_3$ related to the biatomic alcohols $C_mH_{2m+2}O_2$, lactic acid, &c. 2. Acids of the formula $C_mH_{2m-8}O_3$ related to the biatomic alcohols $C_mH_{2m-6}O_2$, salicylic, phloretic, &c., acids.

b. Bibasic Acids.—1. Acids of the formula $C_mH_{2m-2}O_4$ related to the biatomic alcohols $C_mH_{2m+2}O_2$, oxalic, succinic, adipic, suberic, &c., acids. 2. Acids of the formula $C_mH_{2m-10}O_4$, related to the glycols $C_mH_{2m-6}O_2$, phtalic acid and its homologues.

β. Unclassed Biatomic Acids.—Description of some of the more important unclassed biatomic acids and their derivatives. Malic, &c., acids.

III.—Triatomic Acids.

α. Triatomic Acids related to Alcohols.—Mono- and bibasic or aldehydic acids. Glyceric acid, &c. Tribasic acids.

β. Unclassed Triatomic Acids.—Description of some of the more important unclassed triatomic acids and their derivatives. Citric acid, &c.

Meta and Para Acids, produced from polyatomic acids by the action of heat, or of dehydrating substances. Multiple or polyradical acids.

C. ANHYDRIDES.

Methods by which anhydrides are obtained. Influence which the discovery of this class of bodies has exerted on chemistry. Mixed anhydrides.

DERIVATIVES OF AMINE, PHOSPHINE, ARSINE, AND STIBINE, CONTAINING BASYLOUS AND CHLOROUS CARBON RADICLES, OR BODIES FORMED ON THE AMMONIA TYPE.

Action of heat upon neutral ammoniacal salts, and nature of the products—oxamide, acetamide, &c. Action of heat upon acid salts of bibasic acids—oxamic, and succinamic acids. Action of heat and of dehydrating substances upon the amides of monatomic acids, acetonitryl, &c., nature of *nitryls*. Action of the halogen ethers upon ammonia at a high temperature—(*e.g.* bromides and iodides of methyl and ethyl), production of compound ammoniacal bases. Derivatives of ammonia may therefore give rise either to bases, acids, or neutral bodies. Those which yield bases may be considered as ammonia in which part or the whole of the hydrogen has been displaced by a basylous carbon radicle. The neutral and acid derivatives may be considered as ammonia in which part or the whole of the hydrogen is displaced by chlorous carbon radicles. Similar derivatives may be obtained from phosphine, arsine, and stibine. Amine, phosphine, arsine, and stibine derivatives may be supposed to be derived from one, two, or more equivalents of ammonia, phosphine, &c., monamines, diamines, monophosphines, &c. Each of these is subdivided into primary, secondary, and tertiary, &c.

Methods by which derivatives of ammonia, &c., are obtained. Description of the more important derivatives:—

1. Monamines, monophosphines, &c.
2. Diamines, diphosphines, &c., ureas, generalities, on ureas, normal urea, compound ureas.
3. Triamines and higher polyammonias, &c.

Mixed Types.

CHLORHYDRIC ACID—WATER TYPE.

Chlor-, brom- and iodhydrines, &c., in which the whole of the oxygen or sulphur of the hydrates has not been removed.

WATER-AMMONIA TYPE.

Hydrates and oxy-salts of ammoniums, phosphoniums, arsoniums, stiboniums; hydoramines; hydoramides—amic acids.

CHLORHYDRIC ACID—WATER—AMMONIA TYPE.

Bodies which may be considered to be derived from the three types.

NATURAL ALKALOIDS OR VEGETABLE DERIVATIVES OF AMMONIA.

Description of some of the more important bodies of this class. Classification of natural bases according to the families of plants from which they are obtained:—

Caesalpineae—surinamine, jamaicine.
Papilionaceae—sparteine.
Rutaceae—harmaline, harmine.
Diosmeae—cusparine.
Euphorbiaceae—crotonine, buxine.
Erythroxyleae—coccaïne.
Meliaceae—azadarine, carapine.
Büttneriaceae—theobromine.
Papaveraceae—opium bases, (morphine, codeine, thebaine, papaverine, narcotine, narceine), bases of the Eschscholtzia, bases of the Chelidonium majus—(chelidonine, chelerythrine), bases of Glaucium luteum—(glaucine, glaucopicrine).
Fumariaceae—corydaline, fumarine.
Ranunculaceae—aconitine, delphine, staphisine.
Menispermeae—menispermine, pelosine or cissampeline.
Berberideae—oxycanthine.
Umbelleferae—conine, conhydrine, cynapine, cicutine.
Rubiaceae—cinchona bases, (quinine, quinidine, quinicine, cinchonine, cinchonidine, cinchonicine, aricine), emetine, caffeine (found also in the families *Camelliaceae*, *Sapindaceae*, &c.).
Loganieae—strychnine, brucine, igasurine, curarine.
Solenaceae—nicotine, solanine, atropine, hyoscyamine, daturine, stramonine, capsicine.

Thymelaeae—daphnine.
Laurineae—bebeerine.
Piperaceae—piperine.
Palmae—apyrine.
Colchicaceae—colchicine, colchiceine, veratrine, sabadiline, jervine, &c.

DERIVATIVES OF AMMONIA AND PHOSPHINE OCCURRING IN THE ANIMAL BODY.

Mixed derivatives upon the water-ammonia type: Creatine, creatinine, &c., nervous and cerebral matter. Taurocholic, uric, inosic, hippuric and other acids, containing nitrogen; gelatine, albumenoid bodies, white chyle, hæmatine, and other nitrogenous bodies already referred to under the compound ethers of the higher polyatomic alcohols.

Compounds of Oxygen, Sulphur, &c., with Silicon, Titanium, &c.; and Boron.

Silicon.—Protoxide of silicon; hydrous sesquioxide of silicon; silicic anhydride and acid. Silicates; classification of silicates.

[At p. 33 will be found an outline of a new classification in harmony with the present condition of chemical theory, and which the author has used for somewhat more than three years, and which, so far as he knows, he was the first to propose. The formulæ there given are only approximative, and intended merely as examples of the method. It was his intention to have carefully calculated each formula, and to have added those of all the other silicates, but he found that this would have necessitated a complete change in the table, which would be incompatible with the limits of a mere Syllabus. The only change which he has made since last year is the conversion of the sesqui atomic formula of aluminium Al_2 into the triatomic formula Al'''.]

Titanium.—Oxides of titanium. Titanic, anhydride, and acid. Titanates.

Tin.—Stannous oxide and hydrate; stannic anhydride and acid; stannates, metastannates. Salts of tin.

Lead.—Oxides of lead: protoxide, sesquioxide and dioxide of lead; red lead. Salts of lead.

Boron.—Boracic acid, and anhydride; borates.

Compounds with Nitrogen, &c.

Preparation, chemical and physical properties and substitutions of cyanogen; cyanides. Compounds of cyanogen with the halogens. Chlorides, &c., of cyanogen. Combinations with oxygen, sulphur, &c. Cyanic, cyanuric, sulphocyanic acids. Polycyanogens—platino-, palladio-, ferro-, iridio-, ferrid-, cobalto-, chromo-, mangano- cyanogens. Derivatives of cyanogen—mellon, &c.

Nitride of boron.

GROUPS VI. to XI.

Distribution, physical and chemical properties of the more important bodies in each group from VI. to XI., inclusive. Preparation, properties and analogies of their more important combinations, with the halogen and amphigen bodies.

GENERAL SUMMARY.

Comparison of the chief combinations of all the families of simple bodies.

METAMORPHOSIS OF BODIES.

Action of halogen and amphigen bodies upon the other simple bodies; action of acids and basylous hydrates upon simple bodies, upon each other, and upon negative, positive, and mixed anhydrides; action of saline anhydrides upon each other in solution. Laws of Berthollet, Malaguti's coefficients of decomposition; experiments of Bunsen and others on the influence of mass on chemical decomposition. Heterologous, homologous, and isologous transformations of carbon compounds, and the agents by which they are affected.

STOICHEIOMETRY.

Laws of combination by weight. Laws of combination by volume. Gay-Lussac's law, Ampere's law of the molecular constitution of gases. Proportional weights and volumes. Equivalent weights and volumes. Atomic theory. Chemical formulæ—different kinds of formulæ.

EXAMPLES OF THE CLASSIFICATION OF BODIES ACCORDING TO TYPES OF DOUBLE DECOMPOSITION.

I. CHLORHYDRIC ACID, OR MONATOMIC TYPE.

Classes of bodies referable to this type:—Chlorides, Bromides, Iodides, Fluorides, and Cyanides of Simple and Compound Radicles, Monatomic Simple Radicles, Hydrides of Basylous Radicles, Aldehyds, or Hydrides of Negative Radicles, Ketones, Nitryls, &c.

CHLOROUS, OR NEGATIVE SERIES.

HCl Chlorhydric acid.
HI Iodhydric acid.
HCN Cyanhydric acid.
HNO_2 Hydride of nitryl (*nitrous acid*).
HC_2H_3O Hydride of acetyl (*Aldehyd*).
HC_9H_7O Hydride of cinnamyl.
HC_7H_5O Hydride of benzoyl.
$HC_9(H_3Cl_4)O$ Hydride of tetrachlorcinnamyl.
$HC_7(H_4NO_2)S$ Hydride of thio-nitrobenzoyl.
$ClCl$ Chloride of chlorine.
$CyCl$ Chloride of cyanogen.
$NOCl$ Chloride of azotyl.
C_7H_5OCl Chloride of benzoyl.
C_7H_4ClOCl Chloride of chlorobenzoyl.
C_9H_7OCy Cyanide of cinnamyl.

INTERMEDIATE SERIES.

Monatomic HCl.

KCl Chloride of potassium.
$NaBr$ Bromide of sodium.
LiF Fluoride of lithium.
$''Hg_2Cl$ Subchloride of mercury.
$(U_2O')Cl$ Chloride of uranyl.
$(SbO')Cl$ Chloride of antimonyl.
NH_4I Iodide of ammonium.
$N(C_2H_5H_3)Cl$ Chloride of mono-methyl-ammonium.
$N(CH_2Pt'H_3)Cl$ Chloride of platoso-methylammonium.
$N(H_3Cu)Cl$ Chloride of cuprammonium.
$N[H_2Cu(NH_4)]Cl$ Chloride of ammo-cuprammonium.
PH_4I Iodide of phosphonium.
C_2H_5Cl Chloride of ethyl.
C_6H_5Cl Chloride of phenyl.

BASYLOUS, OR POSITIVE SERIES.

$H_{''}Cu_2$ Hydride of copper.
HCH_3 Hydride of methyl, or marsh gas.
$HC_6(H_2Cl_3)$ Hydride of trichlorophenyl.
$HC_7[H_5(NO_2)^2]$ Hydride of dinitrotolyl.
KK Potassium.
CH_3CH_3 Methylate of methyl (free methyl molecule).
$C_2H_5C_4H_9$ Ethylate of butyl.
$\left.\begin{array}{l}As(C_2H_3)(C_2H_5)^3\\ As(C_2H_3)(C_2H_5)^3\end{array}\right\}$ Arsenvinyl-triethylium.

C_2H_5Cy Cyanide of ethyl (or *Propionitryl*).
$CH_3C_2H_3O$ Acetone (*ketone* of acetic series).
$CH_3C_5H_9O$ Methyl-valeryl (*ketone*).
$C_2H_5C_4H_7O$ Ethyl-buteryl (*ketone*).
$KC_{10}H_{11}O$ Cumylide of potassium.

Biatomic H_2Cl_2.

$SO_2''Cl_2$ Chloride of sulphuryl.
$CO''Cl_2$ Chloride of carbonyl.
$Cr_2O_2''Cl_2$ Chloride of chromyl.

$Pt''Cl_2$ Chloride of platinicum.
$Cd''Cl_2$ Chloride of cadmium.
HKF_2 Fluoride of potassium and hydrogen.
$Zn''Cy_2$ Cyanide of zinc.
$C_3H_6''Cl_2$ Chloride of propylene.
$C_2H_4''ICl$ Iodo-chloride of ethylene.
$C_2H_4''Cy_2$ Cyanide of ethylene.
$C_2HBr_3Br_2$ Dibromide of tribromethylene.
$[As(CH_3)^3]''I_2$ Iodide of arsentrimethyl.
$[As_2(C_2H_4'')(C_2H_5)^6]''Br_2$ Bromide of ethylene-hexethyl diarsonium.
$[P_2(C_2H_4'')(C_2H_5)^6]''Br_2$ Bromide of ethylene-hexethyl diphosphonium.

$H_2C_2H_4''$ Hydride of ethylene.
$H_2C_3H_6''$ Hydride of propylene.

Triatomic H_3Cl_3.

$P'''Cl_3$ Chloride of phosphorus, or chloraldehyd of phosphorous acid.

$Au'''Cl_3$ Trichloride of gold.
$(Fe_2)'''Cl_3$ Ferric cyanide.

$H_3C_3H_5'''$ Hydride of glyceryl.
H_3N Ammonia, or hydride of nitrogen.

I. CHLORHYDRIC ACID, OR MONATOMIC TYPE—continued.

Chlorous, or Negative Series.	Intermediate Series.	Basylous, or Positive Series.
$PO'''Cl_3$ Chloride of phosphoryl.	$Al'''Cl_3$ Chloride of aluminium.	H_3Sb Stibine, or hydride of antimony.
$PCl_2'''Cl_3$ Chloride of chloroposphhoryl, or pentachloride of P.	$C_3H_5'''Cl_3$ Chloride of glyceryl, or trichlorhydrin.	
$PS'''Cl_3$ Chloride of sulphophosphoryl.	$C_3H_5'''Br.Cl_2$ Bromodichlorhydrin.	
$Cy_3'''Cl_3$ Chloride of cyanuryl (solid chloride of cyanogen).	$[As(C_2H_3)(C_2H_5)^3]'Pt''Cl_3$ Chloro-platinate of chloride of arsenvinyl-trimethylium.	
$As'''F_3$ Fluoride of arsenic.		
$C_6H_5O_4'''Cl_3$ Chloride of citryl.		
	Tetratomic H_4Cl_4.	
$C''''Cl_4$ Chloride of carbon.	$\left.\begin{matrix}N(CH_3)H_3' \\ Au'''\end{matrix}\right\} Cl_4 \left\{\begin{matrix}\text{Chloro-aurate of methyl-} \\ \text{ammonium.}\end{matrix}\right.$	H_4C'''' Marsh gas.
$Si''''Cl_4$ Chloride of silicon.		H_4Si'''' Silicide of hydrogen.
$Ti''''Cl_4$ Chloride of titanium.		
$Sn''''Cl_4$ Stannic chloride.		
	Hexatomic H_6Cl_6.	
	$W^{vi}Cl_6$ Chloride of tungsten.	
	$(Fe)'_2K_4Cy_6$ Ferri-cyanide of potassium.	
	$(Fe_2)'''K_3Cy_6$ Ferro-cyanide of potassium.	
	$(Co_2)'''K_3Cy_6$ Cobalto-cyanide of potassium.	

II. WATER, OR BIATOMIC TYPE.

Classes of bodies referable to this type:—Oxy-, Sulpho-, &c., Acids, and Basylous Hydrates (Hydrates of Metals and Alcohols); Chlorous, or Negative Anhydrides, Basylous Anhydrides, or Oxides, Sulphides, Selenides and Tellurides of Metals and Alcohol Radicles, Mixed Anhydrides (Metallic Salts and Compound Ethers).

CHLOROUS, OR NEGATIVE SERIES.	BASYLOUS, OR POSITIVE SERIES.
Acids.	**Hydrates.**
Monatomic $\left.\begin{matrix}H\\H\end{matrix}\right\}O.$	*Monatomic* $\left.\begin{matrix}H\\H\end{matrix}\right\}O.$
$\left.\begin{matrix}H\\H\end{matrix}\right\}S$ Sulphydric acid.	$\left.\begin{matrix}K\\H\end{matrix}\right\}O$ Hydrate of potassium.
$\left.\begin{matrix}CN\\H\end{matrix}\right\}S$ Sulphocyanic acid.	$\left.\begin{matrix}Ca'\\H\end{matrix}\right\}O$ Hydrate of calcium.
$\left.\begin{matrix}ClO_2\\H\end{matrix}\right\}O$ Chloric acid.	$\left.\begin{matrix}Ba'\\H\end{matrix}\right\}S$ Sulphydrate of barium.
$\left.\begin{matrix}NO_2\\H\end{matrix}\right\}O$ Nitric acid.	$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$ Ethylic, or common alcohol.
$\left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}O$ Acetic acid.	$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}S$ Sulphydrate of ethyl.
$\left.\begin{matrix}C_2Cl_3O\\H\end{matrix}\right\}O$ Chloroacetic acid.	$\left.\begin{matrix}C_5H_{11}\\H\end{matrix}\right\}S$ Sulphydrate of amyl.
$\left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}S$ Thiacetic acid.	$\left.\begin{matrix}C_{16}H_{33}\\H\end{matrix}\right\}O$ Cetylic alcohol.
$\left.\begin{matrix}C_{18}H_{35}O\\H\end{matrix}\right\}O$ Stearic acid.	$\left.\begin{matrix}NH_4\\H\end{matrix}\right\}O$ Hydrate of ammonium.
$\left.\begin{matrix}C_5H_7O\\H\end{matrix}\right\}O$ Angelic acid.	$\left.\begin{matrix}NHg_4\\H\end{matrix}\right\}O$ Hydrate of tetra-mercurammonium.

II. WATER, OR BIATOMIC TYPE—continued.

Chlorous, or Negative Series.

Acids—*continued.*

$\left.\begin{matrix}C_7H_5O\\H\end{matrix}\right\}O$ Benzoic acid.

$\left.\begin{matrix}C_7H_4ClO\\H\end{matrix}\right\}O$ Chloro-benzoic acid.

$\left.\begin{matrix}C_9H_7O\\H\end{matrix}\right\}O$ Cinnamic acid.

$\left.\begin{matrix}C_9H_6(NO_2)O\\H\end{matrix}\right\}O$ Nitrocinnamic acid.

$\left.\begin{matrix}C_{10}H_4Cl_3SO_2\\H\end{matrix}\right\}O$ Trichlorosulpho-naphthalic acid.

$\left.\begin{matrix}[N(C_4H_4O_2)''H_2]'\\H\end{matrix}\right\}O$ Malamic, or aspartic acid.

$\left.\begin{matrix}[N(C_6H_5)'(C_6H_5O_4)''']'\\H\end{matrix}\right\}O$ Phenylcitramic or citranilic acid.

Biatomic $\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2$.

$\left.\begin{matrix}SO_2''\\H_2\end{matrix}\right\}O_2$ Sulphuric acid.

$\left.\begin{matrix}S\left\{\begin{matrix}S\\O\end{matrix}\right\}''\\H\end{matrix}\right\}O_2$ Thiosulphuric, or hyposulphurous acid.

$\left.\begin{matrix}Mn_2O_2''\\H_2\end{matrix}\right\}O_2$ Manganic acid.

Basylous, or Positive Series.

Hydrates—*continued.*

$\left.\begin{matrix}[N(C_2H_5)^3(C_5H_{11})]'\\H\end{matrix}\right\}O$ Hydrate of triethyl-amylium.

$\left.\begin{matrix}[N(C_6H_5)H_3]'\\H\end{matrix}\right\}S$ Sulphydrate of phenyl-ammonium.

$\left.\begin{matrix}[P(C_2H_5)^4]'\\H\end{matrix}\right\}O$ Hydrate of tetrethyl-phosphonium.

$\left.\begin{matrix}[As(C_2H_3)(C_2H_5)^3]'\\H\end{matrix}\right\}O$ Hydrate of arsen-vinyltriethylium.

$\left.\begin{matrix}[Sb(CH_3)(C_2H_5)^3]'\\H\end{matrix}\right\}O$ Hydrate of stib-methyl-triethylium.

Biatomic $\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2$.

$\left.\begin{matrix}Pt''\\H_2\end{matrix}\right\}O_2$ Platinic hydrate.

$\left.\begin{matrix}Pd''\\H_2\end{matrix}\right\}O_2$ Palladic hydrate.

$\left.\begin{matrix}C_2H_4''\\H_2\end{matrix}\right\}O_2$ Ethylenic alcohol, or glycol.

$\left.\begin{matrix}Cr_2O_2''\\H_2\end{matrix}\right\}O_2$ Chromic acid.

$\left.\begin{matrix}C_2O_2''\\H_2\end{matrix}\right\}O_2$ Oxalic acid.

$\left.\begin{matrix}C_4H_4O_2''\\H_2\end{matrix}\right\}O_2$ Succinic acid.

$\left.\begin{matrix}C_4H_4O_3''\\H_2\end{matrix}\right\}O_2$ Malic acid.

Triatomic $\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_3$.

$\left.\begin{matrix}PO'''\\H_3\end{matrix}\right\}O_3$ Ortho-phosphoric acid.

$\left.\begin{matrix}P'''\\H_3\end{matrix}\right\}O_3$ Phosphorous acid.

$\left.\begin{matrix}AsO'''\\H_3\end{matrix}\right\}O_3$ Ortharsenic acid.

$\left.\begin{matrix}Cy_3\\H_3\end{matrix}\right\}O_3$ Cyanuric acid.

$\left.\begin{matrix}C_6H_5O_4'''\\H_3\end{matrix}\right\}O_3$ Citric acid.

Tetratomic $\left.\begin{matrix}H_4\\H_4\end{matrix}\right\}O_4$.

$\left.\begin{matrix}Si^{iv}\\H_4\end{matrix}\right\}O_4$ Ortho-silicic acid.

$\left.\begin{matrix}Ti^{iv}\\H_4\end{matrix}\right\}O_4$ Ortho-titanic acid.

$\left.\begin{matrix}C_5H_{10}''\\H_2\end{matrix}\right\}O_2$ Amylenic alcohol, or amyl-glycol.

$\left.\begin{matrix}\left[\begin{matrix}(C_2H_5)^3As\\C_2H_4''H_3N\end{matrix}\right]''\\H_2\end{matrix}\right\}O_2$ Hydrate of ethylene triethyl arsammonium.

Triatomic $\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_3$.

$\left.\begin{matrix}Bi'''\\H_3\end{matrix}\right\}O_3$ Ortho-hydrate of bismuth.

$\left.\begin{matrix}Al'''\\H_3\end{matrix}\right\}O_3$ Ortho-Hydrate of aluminium.

$\left.\begin{matrix}Fe_2'''\\H_3\end{matrix}\right\}O_3$ Ortho-ferric hydrate.

$\left.\begin{matrix}C_3H_5'''\\H_3\end{matrix}\right\}O_3$ Hydrate of glyceryl, or glycerine.

Tetratomic $\left.\begin{matrix}H_4\\H_4\end{matrix}\right\}O_4$.

$\left.\begin{matrix}C_4H_6^{iv}\\H_4\end{matrix}\right\}O_4$ Erythromannite.

II. WATER, OR BIATOMIC TYPE—continued.

CHLOROUS, OR NEGATIVE SERIES.

Acids—*continued.*

Hexatomic $\left.\begin{matrix}H_6 \\ H_6\end{matrix}\right\} O_6$.

$\left.\begin{matrix}C_4H_2O_2^{iv} \\ (C_3H_5)''' \\ H_6\end{matrix}\right\} O_6$ Glycerotartaric acid.

CHLOROUS, OR NEGATIVE SERIES.

Anhydrides.

Monatomic $\left.\begin{matrix}H \\ H\end{matrix}\right\} O$.

$\left.\begin{matrix}NO_2' \\ NO_2'\end{matrix}\right\} O$ Nitric anhydride.

$\left.\begin{matrix}ClO_2 \\ ClO\end{matrix}\right\} O$ Chloroso-chloric anhydride.

$\left.\begin{matrix}C_7H_5O \\ C_7H_5O\end{matrix}\right\} O$ Benzoic anhydride.

$\left.\begin{matrix}C_2H_3O \\ C_7H_5O\end{matrix}\right\} O$ Aceto-benzoic anhydride.

$\left.\begin{matrix}C_7H_5O \\ C_9H_{17}O\end{matrix}\right\} O$ Benzo-pelargonic anhydride.

$\left.\begin{matrix}C_7H_5O \\ C_7H_5O\end{matrix}\right\} S$ Sulphide of benzoyl.

$\left.\begin{matrix}C_7H_4(NO_2)O \\ C_7H_4(NO_2)O\end{matrix}\right\} O$ Nitro-benzoic anhydride.

INTERMEDIATE SERIES, OR OXI-SALTS AND ETHERS.

Monatomic $\left.\begin{matrix}H \\ H\end{matrix}\right\} O$.

$\left.\begin{matrix}ClO_2 \\ K\end{matrix}\right\} O$ Chlorate of potassium.

$\left.\begin{matrix}BrO_2 \\ Ca'\end{matrix}\right\} O$ Bromate of calcium.

$\left.\begin{matrix}CN \\ NH_4\end{matrix}\right\} O$ Cyanate of ammonium.

$\left.\begin{matrix}C_7H_5O \\ Ag\end{matrix}\right\} O$ Benzoate of silver.

$\left.\begin{matrix}C_2H_3O \\ Na\end{matrix}\right\} S$ Thiacetate of sodium.

$\left.\begin{matrix}C_2Cl_3O \\ K\end{matrix}\right\} O$ Trichloracetate of potassium.

$\left.\begin{matrix}C_2H_3O \\ C_2H_5\end{matrix}\right\} O$ Acetate of ethyl.

BASYLOUS, OR POSITIVE SERIES.

Hydrates—*continued.*

Hexatomic $\left.\begin{matrix}H_6 \\ H_6\end{matrix}\right\} O_6$.

$\left.\begin{matrix}C_6H_6^{vi} \\ H_6\end{matrix}\right\} O_6$ Grape Sugar.

$\left.\begin{matrix}C_6H_8^{vi} \\ H_6\end{matrix}\right\} O_6$ Mannite.

BASYLOUS, OR POSITIVE SERIES.

Anhydrides.

Monatomic $\left.\begin{matrix}H \\ H\end{matrix}\right\} O$.

$\left.\begin{matrix}K \\ K\end{matrix}\right\} O$ Oxide of potassium.

$\left.\begin{matrix}Ba' \\ Ba'\end{matrix}\right\} S$ Sulphide of barium.

$\left.\begin{matrix}Zn' \\ K\end{matrix}\right\} O$ Zincate of potassium.

$\left.\begin{matrix}C_2H_5 \\ C_2H_5\end{matrix}\right\} O$ Oxide of ethyl (ether)

$\left.\begin{matrix}C_2H_5 \\ C_2H_5\end{matrix}\right\} S$ Sulphide of ethyl.

$\left.\begin{matrix}C_2H_5 \\ K\end{matrix}\right\} O$ Ethylo-potassic oxide.

$\left.\begin{matrix}C_2H_5 \\ Na\end{matrix}\right\} S$ Ethylo-sodic sulphide.

$\left.\begin{matrix}CN\\ C_7H_5O\end{matrix}\right\}S$ Sulphocyanate of benzoyl.

$\left.\begin{matrix}CN\\ C_2H_3O\end{matrix}\right\}O$ Acetate of cyanogen.

Biatomic $\left.\begin{matrix}H_2\\ H_2\end{matrix}\right\}O_2$.

$SO_2''O$ Sulphuric anhydride.
$Cr_2O_2''O$ Chromic anhydride.
$C_4H_4O_2''O$ Succinnic anhydride.
$C_5H_4O_2''O$ Citraconic anhydride.

$\left.\begin{matrix}C_2H_3O\\ C_2H_5\end{matrix}\right\}S$ Thiacetate of ethyl.

$\left.\begin{matrix}C_2Cl_3O\\ C_2Cl_5\end{matrix}\right\}O$ Perchlorinated acetate of ethyl.

$\left.\begin{matrix}C_9H_6(NO_2)O\\ C_5H_{11}\end{matrix}\right\}O$ Nitrocinnamate of amyl.

$\left.\begin{matrix}CN\\ C_2H_5\end{matrix}\right\}S$ Sulphocyanate of ethyl.

$\left.\begin{matrix}NH_3Cu\\ NO_2\end{matrix}\right\}O$ Nitrate of cuprammonium.

$\left.\begin{matrix}N(C_2H_5)^4\\ C_2H_3O'\end{matrix}\right\}O$ Acetate of tetrethylium.

$\left.\begin{matrix}As(CH_3)^2(C_5H_{11})^2\\ NO_2\end{matrix}\right\}$ Nitrate of arsendimethyl-diamylium.

$\left.\begin{matrix}NH_2(CO'')\\ C_2H_5\end{matrix}\right\}O$ {Carbamate of ethyl, or carbamethane.

Biatomic $\left.\begin{matrix}H_2\\ H_2\end{matrix}\right\}O_2$.

$\left.\begin{matrix}SO_2''\\ K_2\end{matrix}\right\}O_2$ Neutral sulphate of potassium.

$\left.\begin{matrix}\left(S\left\{\begin{matrix}O\\ S\end{matrix}\right.\right)''\\ Na_2\end{matrix}\right\}O_2$ {Thiosulphate, or hyposulphite of sodium.

$\left.\begin{matrix}SO_2''\\ C_2H_5,H\end{matrix}\right\}O_2$ {Acid sulphate of ethyl, or sulphovinic acid.

$\left.\begin{matrix}SO_2''\\ C_2H_5,K\end{matrix}\right\}O_2$ Ethylsulphate of potassium.

$\left.\begin{matrix}C_2H_3Cl_2\\ C_2H_3Cl_2\end{matrix}\right\}O$ Dichlorethylic oxide.

$\left.\begin{matrix}C_2H_3Cl_2\\ C_2H_3S\end{matrix}\right\}O$ Dichlorsulphethylic oxide.

$\left.\begin{matrix}C_2H_3S\\ C_2H_3S\end{matrix}\right\}O$ Sulphethylic oxide.

$\left.\begin{matrix}C_6H_5\\ C_6H_5\end{matrix}\right\}O$ Phenylic oxide.

$\left.\begin{matrix}C_2H_5\\ C_8H_{17}\end{matrix}\right\}O$ Ethyl-octylic oxide.

$\left.\begin{matrix}CH_3\\ C_5H_{11}\end{matrix}\right\}O$ Methyl-amylic oxide.

$\left.\begin{matrix}C_2H_5\\ C_2H_5\end{matrix}\right\}T$ Tellurethyl.

$\left.\begin{matrix}As(C_2H_5)^4\\ As(C_2H_5)^4\end{matrix}\right\}O$ Oxide of arsentetrethylium.

Biatomic $\left.\begin{matrix}H_2\\ H_2\end{matrix}\right\}O_2$.

Pt''_2O_2 Platinic oxide.
Pd''_2O_2 Palladic oxide.
$C_2H_4''O$ Oxide of ethylene.
$C_5H_{10}''O$ Oxide of amylene.

$\left.\begin{matrix}C_2H_4''\\ Na,H\end{matrix}\right\}O_2$ Monosodic ethylenate.

$\left.\begin{matrix}C_2H_4''\\ Na_2\end{matrix}\right\}O_2$ Disodic ethylenate.

II. WATER, OR BIATOMIC TYPE—continued.

CHLOROUS, OR NEGATIVE SERIES.	INTERMEDIATE SERIES, OR OXI-SALTS AND ETHERS.	BASYLOUS, OR POSITIVE SERIES.
Anhydrides—*continued.*		**Anhydrides**—*continued.*
	$\left.\begin{matrix}SO_2''\\(C_2H_5)_2\end{matrix}\right\}O_2$ Neutral sulphate of ethyl.	$\left.\begin{matrix}C_2H_4''\\C_2H_5,H\end{matrix}\right\}O_2$ Monethylate of ethylene.
	$\left.\begin{matrix}C_2O_2''\\C_2H_5,H\end{matrix}\right\}O_2$ Acid oxalate of ethyl.	$\left.\begin{matrix}C_2H_4''\\(C_2H_5)_2\end{matrix}\right\}O_2$ Diethylate of ethylene.
	$\left.\begin{matrix}CO''\\(CH_3)_2\end{matrix}\right\}O_2$ Carbonate of methyl.	$\left.\begin{matrix}C_7H_6''\\(C_2H_5)_2\end{matrix}\right\}O_2$ Diethylate of benzylene.
	$\left.\begin{matrix}CS''\\(C_2H_5)_2\end{matrix}\right\}S_2$ Diethylic sulpho-carbonate.	$\left.\begin{matrix}C_2H_4''\\C_2H_4''\end{matrix}\right\}O_2$ Dioxethylene.
	$\left.\begin{matrix}CO''\\C_5H_{11},H\end{matrix}\right\}S_2$ Amylosulpho-carbonic acid.	
	$\left.\begin{matrix}SO_2''\\{[N(C_2H_5,H_3)']_2}\end{matrix}\right\}O_2$ Neutral sulphate of ethylammonium.	
	$\left.\begin{matrix}(C_4H_{10}Te)''\\(NO_3)_2\end{matrix}\right\}O_2$ Nitrate of tellurethyl.	
	$\left.\begin{matrix}C_2H_4''\\C_2H_3O'\\H\end{matrix}\right\}O_2$ Monacetate of ethylene.	
	$\left.\begin{matrix}C_2H_4''\\(C_{18}H_{35}O)_2\end{matrix}\right\}O_2$ Distearate of ethylene.	
	$\left.\begin{matrix}C_2H_4''\\C_2H_3O'\\C_4H_7O'\end{matrix}\right\}$ Aceto-butyrate of ethylene.	
	$\left.\begin{matrix}C_2H_4''\\(CN)_2\end{matrix}\right\}S_2$ Sulphocyanate of ethylene.	

Triatomic $\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_3$.

$\left.\begin{matrix}PO'''\\PO'''\end{matrix}\right\}O_3$ Phosphoric anhydride.

$\left.\begin{matrix}As'''\\As'''\end{matrix}\right\}O_3$ Arsenious anhydride.

$\left.\begin{matrix}AsS'''\\AsS'''\end{matrix}\right\}S_3$ Sulpharsenic anhydride.

$\left.\begin{matrix}(C_4H_4O_2)''\\(C_2H_4)''\end{matrix}\right\}O^2$ Succinate of ethylene.

$\left.\begin{matrix}SO_2''\\ [N_2H_8Cu_2,(NH_4)_3]''\end{matrix}\right\}O_2$ $\left\{\begin{matrix}\text{Sulphate of tri-}\\ \text{ammo-dicupro-}\\ \text{diammonium.}\end{matrix}\right.$

Triatomic $\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_3$.

$\left.\begin{matrix}PO'''\\Na_2,H\end{matrix}\right\}O_3$ Ortho-disodic phosphate.

$\left.\begin{matrix}AsS'''\\K_3\end{matrix}\right\}S_3$ $\left\{\begin{matrix}\text{Ortho-sulpharsenate of pot-}\\ \text{assium.}\end{matrix}\right.$

$\left.\begin{matrix}SbS'''\\Na_3\end{matrix}\right\}S_3$ $\left\{\begin{matrix}\text{Ortho-sulphantimonate of so-}\\ \text{dium.}\end{matrix}\right.$

$\left.\begin{matrix}(NO)'''\\Hg_3\end{matrix}\right\}O_3$ Ortho-nitrate of mercuricum.

$\left.\begin{matrix}PO'''\\C_2H_5,H_2\end{matrix}\right\}O_3$ Monethylo-phosphoric acid.

$\left.\begin{matrix}PO'''\\(C_2H_5)^2H\end{matrix}\right\}O_3$ Diethylo-phosphoric acid.

$\left.\begin{matrix}PO'''\\(C_2H_5)^3\end{matrix}\right\}O_3$ Neutral phosphate of ethyl.

$\left.\begin{matrix}C_6H_5O_4'''\\CH_3,H_2\end{matrix}\right\}O_3$ Monomethylic citrate.

$\left.\begin{matrix}C_6H_5O_4'''\\(CH_2)^3\end{matrix}\right\}O_3$ Neutral citrate of ethyl.

Triatomic $\left.\begin{matrix}H_3\\H_3\end{matrix}\right\}O_3$.

$\left.\begin{matrix}Bi'''\\Bi'''\end{matrix}\right\}O_3$ Teroxide of bismuth.

$\left.\begin{matrix}Fe_2'''\\Fe_2'''\end{matrix}\right\}O_3$ Ferric oxide.

$\left.\begin{matrix}Fe_2'''\\Fe_2'''\end{matrix}\right\}S_3$ Ferric sulphide.

$\left.\begin{matrix}C_3H_5'''\\C_3H_5'''\end{matrix}\right\}O_3$ Oxide of glyceryl.

II. WATER, OR BIATOMIC TYPE—continued.

CHLOROUS, OR NEGATIVE SERIES.

Anhydrides—*continued.*

INTERMEDIATE SERIES, OR OXI-SALTS AND ETHERS.

$\left.\begin{matrix} PO''' \\ (N,C_2H_5,H_3)^3 \end{matrix}\right\} O_3$ Neutral phosphate of ethylammonium.

$\left.\begin{matrix} PS''' \\ (C_2H_5)^2 \\ C_5H_{11} \end{matrix}\right\} O_3$ Amylo-diethylic sulphophosphate.

$\left.\begin{matrix} N_3[Co_2'''(NH_4)^3H_6]''' \\ (NO_2)^3 \end{matrix}\right\} O_3$ Hexammonio cobaltic nitrate (luteo-cobaltic nitrate.)

$\left.\begin{matrix} C_3H_5''' \\ C_{18}H_{35}O \\ H_2 \end{matrix}\right\} O_3$ Monostearin.

$\left.\begin{matrix} C_3H_5''' \\ (C_{18}H_{35}O)^2 \\ H \end{matrix}\right\} O_3$ Distearin.

$\left.\begin{matrix} C_3H_5''' \\ (C_{18}H_{35}O)^3 \end{matrix}\right\} O_3$ Tristearin.

$\left.\begin{matrix} C_3H_5''' \\ C_4H_4O_2'' \\ H \end{matrix}\right\} O_3$ Succinin.

$\left.\begin{matrix} C_3H_5''' \\ C_4H_4O_2'' \\ C_7H_5O' \end{matrix}\right\} O_3$ Benzosuccinin.

BASYLOUS, OR POSITIVE SERIES.

Anhydrides—*continued.*

Tetratomic $\left.\begin{matrix}H_4\\H_4\end{matrix}\right\}O_4$.

$C^{iv}O_2$ Carbonic anhydride.
$Si^{iv}O_2$ Silicic anhydride.
$Ti^{iv}O_2$ Titanic anhydride.
$Sn^{iv}O_2$ Stannic anhydride.

$\left.\begin{matrix}C_3H_5'''\\C_6H_5O_4'''\end{matrix}\right\}O_3$ Citrin.

$\left.\begin{matrix}PO'''\\Bi'''\end{matrix}\right\}O_3$ Phosphate of bismuth.

Tetratomic $\left.\begin{matrix}H_4\\H_4\end{matrix}\right\}O_4$.

$\left.\begin{matrix}Si^{iv}\\Zn'_4\end{matrix}\right\}O_4$ Silicate of zinc (with H_2O it forms hemimorphite or calamine).

$\left.\begin{matrix}Si^{iv}\\Ca'\\Al'''\end{matrix}\right\}O_2$ Anorthite.

$\left.\begin{matrix}C_4H_6^{iv}\\C_8H_7O_3'\\H_3\end{matrix}\right\}O_4$ Erythromannite mono-orsellate.

$\left.\begin{matrix}C_4H_6^{iv}\\(C_7H_5O')_2\\H_2\end{matrix}\right\}O_4$ Erythromannite dibenzoate.

Hexatomic $\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}O_6$.

$\left.\begin{matrix}C_6H_6^{vi}\\(NO_2)_6\end{matrix}\right\}O_6$ Hex-nitro-inosite.

$\left.\begin{matrix}(C_6H_8)^{vi}\\(NO_2)_6\end{matrix}\right\}O_6$ Hex-nitro-dulcite.

HYDRATES OF MULTIPLE-, OR POLYRADICLES, AND THEIR SALTS AND ETHERS,

Including meta- and para- acids, and hydrates of multiple or polyradicles, and their salts and ethers; basic salts, and certain acid-salts; and the majority of natural silicates.

Chlorous, or Negative Series.	Intermediate, or Saline Series. Multiples of Biatomic Radicles.		Basylous, or Positive Series.
	$\left.\begin{matrix}(SO_2'')_2\\Na_2\end{matrix}\right\}O_3$. Parasulphate of sodium.	$\left.\begin{matrix}(C_2H_4'')_2\\(C_2H_5),H\end{matrix}\right\}O_3$. Diethylenic monethylate.	
$\left.\begin{matrix}(SO_2'')_2\\H_2\end{matrix}\right\}O_3$. Parasulphuric acid, or Nordhausen acid.	$\left.\begin{matrix}(TeO_2'')_2\\K_2\end{matrix}\right\}O_3$. Paratellurate of potassium.	$\left.\begin{matrix}(C_2H_4'')_2\\(C_2H_3'O)_2\end{matrix}\right\}O_3$. Diethylenic diacetate.	$\left.\begin{matrix}(C_2H_4'')_2\\H_2\end{matrix}\right\}O_3$. Diethylenic Alcohol.
$\left.\begin{matrix}(SO_2'')_4\\NO\\H_7\end{matrix}\right\}O_9$. Sulphammonic acid.	$\left.\begin{matrix}(TeO_2'')_4\\K_2\end{matrix}\right\}O_5$. Tetratellurate of potassium.	$\left.\begin{matrix}C_2H'')_3\\(C_2H_3'O)_2\end{matrix}\right\}O_4$. Triethylenic diacetate.	$\left.\begin{matrix}(C_2H_4'')_3\\H_2\end{matrix}\right\}O_4$. Triethylenic alcohol.
$\left.\begin{matrix}(C_2H_2O'')_2\\H_2\end{matrix}\right\}O_3$. Diglycollic acid.	$\left.\begin{matrix}(Cr_2''O_2)_2\\K_2\end{matrix}\right\}O_3$. Parachromate of potassium (potassic dichromate).	$\left.\begin{matrix}(C_2H_4'')_6\\(C_7H_5O)_2\end{matrix}\right\}O_7$. Hexethylenic dibenzoate.	$\left.\begin{matrix}(C_2H_4'')_4\\H_2\end{matrix}\right\}O_5$. Tetrethylenic alcohol.
			$\left.\begin{matrix}(C_2H_4'')_5\\H_2\end{matrix}\right\}O_6$. Pentethylenic alcohol.

$\left.\begin{matrix}(C_2H_4)'' \\ (C_2H_2''O)_2 \\ H_2\end{matrix}\right\} O_4.$

Diglycol-ethylenic acid.

$\left.\begin{matrix}(SO_2'')_2 \\ Cr_2O_2'')_6 \\ K_8\end{matrix}\right\} O_{12}.$

Parachromo-sulphate of potassium.

$\left.\begin{matrix}(SO'')_4 \\ NO \\ Ba'_3,K,H_3\end{matrix}\right\} O_8.$

Sulphammonate of barium, potassium, and hydrogen.

$\left.\begin{matrix}(C_2H_4'')_6 \\ H_2\end{matrix}\right\} O_7.$

Hexethylenic alcohol.

Multiples of Triatomic Radicles.

$\left.\begin{matrix}PO''' \\ H\end{matrix}\right\} O_2.$

Metaphosphoric acid.

$\left.\begin{matrix}(PO'')_2 \\ H_4\end{matrix}\right\} O_5.$

Paraphosphoric acid.

$\left.\begin{matrix}(As''')_2 \\ K_2\end{matrix}\right\} S_4.$

Metasulpharsenite of potassium.

$\left.\begin{matrix}(Sb''')_2 \\ Pb'_4\end{matrix}\right\} S_5.$

Parasulphantimonite of lead (feather ore).

$\left.\begin{matrix}(C_3H_5''')_2 \\ (C_2'H_5)_3 \\ H\end{matrix}\right\} O_6.$

Triethyl-paraglycerin (triethyl-pyroglycerin).

$\left.\begin{matrix}(C_3H_5''')_3 \\ (C_2'H_5)_4 \\ H\end{matrix}\right\} O_7.$

Tetrethyl-triglycerin.

$\left.\begin{matrix}C_3H_5''' \\ H\end{matrix}\right\} O_3.$

Glycide or meta-hydrate of glyceryl.

$\left.\begin{matrix}(C_3H_5''')_2 \\ H_4\end{matrix}\right\} O_5.$

Paraglycerin (diglycerin).

HYDRATES OF MULTIPLE-RADICLES, AND THEIR SALTS AND ETHERS—continued.

Multiples of Triatomic Radicles—*continued.*

Chlorous, or Negative Series.	Intermediate, or Saline Series.		Basylous, or Positive Series.
$\left.\begin{matrix}(PO''')_2\\H_2\end{matrix}\right\}O_4$. Theoretical acid of Maddrel's salt.	$\left.\begin{matrix}(PO''')_2\\Na_4\end{matrix}\right\}O_5$. Paraphosphate of sodium (pyrophosphate).	$\left.\begin{matrix}(Fe_2''')_6\\SO_2''\end{matrix}\right\}O_{10}$. (Tribasic ferric sulphate).	$\left.\begin{matrix}(C_3H_5''')_2\\H_2\end{matrix}\right\}O_4$. Diglycide.
$\left.\begin{matrix}(PO''')_3\\H_3\end{matrix}\right\}O_6$. Theoretical meta-acid of Fleitmann and Henneberg's salt.	$\left.\begin{matrix}(SO_2'')_3\\(Fe_2''')\end{matrix}\right\}O_6$. Diacid ferric sulphate.	$\left.\begin{matrix}(Fe_2''')_{12}\\SO_2''\end{matrix}\right\}O_{19}$. (Six-basic ferric sulphate.)	$\left.\begin{matrix}(C_3H_5''')_2\\H_2\end{matrix}\right\}\begin{matrix}O\\S_3\end{matrix}$. Trithio-diglycide.
—	$\left.\begin{matrix}(SO'')_3\\(C_3H_5''')_2\\H_2\end{matrix}\right\}O_7$. Diglyci-trisulphurous acid.		$\left.\begin{matrix}(C_3H_5''')_3\\H_3\end{matrix}\right\}O_6$. Triglycide.
$\left.\begin{matrix}(AsO''')_2\\H_4\end{matrix}\right\}O_5$. Pararsenic acid.	$\left.\begin{matrix}(SO'')_3\\(C_3H_5''')_2\\Na_2\end{matrix}\right\}O_7$. Diglyci-trisulphite of potassium.		$\left.\begin{matrix}(C_3H_5)_3'''\\H_5\end{matrix}\right\}O_7$. Triglycerin.
$\left.\begin{matrix}(SbO''')_2\\H_4\end{matrix}\right\}O_5$. Parantimonic acid (Fremy's Metantimonic acid).			

Multiples of Tetratomic Radicles.

(Classification of Silicates.)*

	SILICIC ACIDS.	TITANIC ACID.	TANTALIC ACID.
Derived from: $\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_3$.	$\left.\begin{matrix}Si^{iv}\\H_2\end{matrix}\right\}O_3$.		$\left.\begin{matrix}Ta^{iv}\\H_2\end{matrix}\right\}O_3$.
$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_7$.	$\left.\begin{matrix}(Si^{iv})_3\\H_2\end{matrix}\right\}O_7$.	$\left.\begin{matrix}(Ti^{iv})_3\\H_2\end{matrix}\right\}O_7$ (?).	
$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_8$.	$\left.\begin{matrix}(Si^{iv})_3\\H_4\end{matrix}\right\}O_8$.		

MONOSILICATES.

—o—

Derived from:	$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_3$.	$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_5$.			$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_8$.	$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{13}$.
	$\left.\begin{matrix}(Si^{iv})\\Ca_2\end{matrix}\right\}O_3$	$\left.\begin{matrix}(Si^{iv})\\(Al''')_2\end{matrix}\right\}O_5$	$\left.\begin{matrix}(Si^{iv})\\(Al''')_2\end{matrix}\right\}O_5, 3H_2O$	$\left.\begin{matrix}(Si^{iv})\\(Al''')_2\end{matrix}\right\}O_5$ 5 or 7 H_2O	$\left.\begin{matrix}(Si^{iv})\\(Al''')_4\end{matrix}\right\}O_8, 10H_2O$	$\left.\begin{matrix}\left[\begin{matrix}(Si)\\(Al''')_2\end{matrix}\right]_2^{xx}\\(Fe_2''')_{2vi}\end{matrix}\right\}O_{13}$
	Wollastonite.	Andalusite. Cyanite, (dimorphic).	Miloschin.	Allophan.	Kollyrite.	Staurolite.

* The smallest proportion of aluminium which has ever been found to exist in a compound being 27·5, and there being no ground whatever for supposing it to be divisible, aluminium has been considered throughout these formulæ as a triatomic metal with twice its usual atomic weight, namely—27·5.

D

HYDRATES OF MULTIPLE-RADICLES, AND THEIR SALTS AND ETHERS—continued.

Multiples of Tetratomic Radicles—*continued.*

DISILICATES.

Derived from : $\left(\begin{matrix}H\\H\end{matrix}\right\}O)_5$.	$\left(\begin{matrix}H\\H\end{matrix}\right\}O)_7$.	$\left(\begin{matrix}H\\H\end{matrix}\right\}O)_8$.		$\left(\begin{matrix}H\\H\end{matrix}\right\}O)_9$.	$\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{11}$.	$\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{20}$.
$\left.\begin{matrix}(Si^{iv})_2\\K_2\end{matrix}\right\}O_5$ Silicate of potassium.	$\left.\begin{matrix}(Si^{iv})_2\\Mg_6\end{matrix}\right\}O_7,3H_2O$ Deweylite.	$\left.\begin{matrix}(Si^{iv})_2\\ [MgFe]_8\end{matrix}\right\}O_8$ Crysolite, Olivine.	$\left.\begin{matrix}(Si^{iv})_2\\ [Ca,K]_2\\ [Al_2'''Fe''']_2\end{matrix}\right\}O_8$ Latrobite.	$\left.\begin{matrix}(Si^{iv})_2\\ [Ca_4Mg_4Fe_2]\end{matrix}\right\}O_9,H_2O$ Batrachite.	$\left.\begin{matrix}(Si^{iv})_2\\Mg_8\\(Al''')_2\end{matrix}\right\}O_{11},3H_2O$ Chlorite.	$\left.\begin{matrix}(Si^{iv})_3\\(C^{iv})_3\\Zn_{20}\end{matrix}\right\}O_{20},14H_2O$ Silico-Carbonate of zinc.
$\left.\begin{matrix}(Si^{iv})_2\\Ca_3\end{matrix}\right\}O_8,2H_2O$ Okenite.	$\left.\begin{matrix}(Si^{iv})_2\\Mg_4\\Fe_2\end{matrix}\right\}O_7,3H_2O$ Hydrophite.	$\left.\begin{matrix}(Si^{iv})_2\\Mg_8\end{matrix}\right\}O_8,H_2O$ Villarsite.	$\left.\begin{matrix}(Si^{iv})_2\\ [Ca,Mg]_2\\(Al''')_2\end{matrix}\right\}O_8$ Amphodelite.			
			$\left.\begin{matrix}(Si^{iv})_2\\Mn_8\\ [Al'''Fe_2''']_2\end{matrix}\right\}O_8,2H_2O$ Karpholite.			

TRISILICATES.

Derived from : $\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{[illegible]}$. $\left(\begin{matrix}H\\H\end{matrix}\right\}O)_9$. $\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{10}$. $\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{11}$. $\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{12}$. $\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{13}$.

8 $\left.\begin{matrix}(Si^{iv})_3\\ Mg_4\end{matrix}\right\}O_8,2H_2O$
Meerschaum.

$\left[\left.\begin{matrix}(Si^{iv})_3\\ Gl_3\\ (Al''')\end{matrix}\right\}O_9\right]^{n}$
Beryl,
Davidsonite.

$\left[\left.\begin{matrix}(Si^{iv})_3\\ M_2'\\ (Al''')_2\end{matrix}\right\}O_{10}\right]^{n}$
Ryacolite.

$\left.\begin{matrix}(Si^{iv})_3\\ Na_2\\ (Al''')_2\end{matrix}\right\}O_{10},2H_2O$
Natrolite, soda
Mesotype.

$\left.\begin{matrix}(Si^{iv})_3\\ Ca_2\\ (Al''')_2\end{matrix}\right\}O_{10},3H_2O$
Skolecite, lime
Mesotype.

$\left(\left.\begin{matrix}H\\ H\end{matrix}\right\}O\right)_{14}.$

$\left.\begin{matrix}(Si^{iv})^{3}_{3}\\ [Gl_6,Mn_8,Fe_2]\end{matrix}\right\}\begin{matrix}S\\ O_{13}\end{matrix}$
Helvîn.

$\left.\begin{matrix}(Si^{iv})_3\\ M_{10}'\\ (Al''')_2\end{matrix}\right\}O_{14},4H_2O$
Ripidolite.

$\left.\begin{matrix}(Si^{iv})_3\\ M_4'\\ (Al''')_2\end{matrix}\right\}O_{11}$
Some uniaxial
micas.

$\left.\begin{matrix}(Si^{iv})_3\\ Ca_4\\ (Al''')_2\end{matrix}\right\}O_{11},H_2O$
Prehnite.

$\left(\left.\begin{matrix}H\\ H\end{matrix}\right\}O\right)_{30}.$

$\left.\begin{matrix}\left(\begin{matrix}(Si^{iv})_3\\ Ca_3\\ (Al''')_2\end{matrix}\right)^{xl}_{2}\\ \left(\begin{matrix}(Si^{iv})_3\\ Na_3\\ (Al''')_2\end{matrix}\right)^{xx}\end{matrix}\right\}O_{30},8H_2O$
Mesolite.

$\left.\begin{matrix}(Si^{iv})_3\\ (Al''')_4\end{matrix}\right\}O_{12}$
Bucholzite,
Xenolite.

$\left.\begin{matrix}(Si^{iv})_3\\ (Al''')_4\end{matrix}\right\}O_{12},4H_2O$
Pholerite.

$\left[\left.\begin{matrix}(Si^{iv})_3\\ M_6'\\ (Al''')_2\end{matrix}\right\}O_{12}\right]^{n}$
Idocrase, Garnet,
Allanite,
Cerin, &c.

$\left.\begin{matrix}(Si^{iv})_3\\ (Ti^{iv})_2\\ Ca_6\end{matrix}\right\}O_{13}$
Titanite.

HYDRATES OF MULTIPLE-RADICLES, AND THEIR SALTS AND ETHERS—*continued.*

Multiples of Tetratomic Radicles—*continued.*

TETRASILICATES.

Derived from $\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_8$.	$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_9$.	$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{12}$.	$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{15}$.	$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{16}$.	$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{17}$.?
$\left.\begin{matrix}(Si^{iv})_4\\M_4\\(Al''')_4\end{matrix}\right\}O_8$ *(Dimorphic)* Wernerite, Skapolite (Anorthite).	$\left.\begin{matrix}(Si^{iv})_4\\K_2\end{matrix}\right\}O_9$ Silicate of potassium.	$\left.\begin{matrix}(Si^{iv})_4\\K_2\\(Al''')_2\end{matrix}\right\}O_{12}$ Leucite.	$\left.\begin{matrix}(Si^{iv})_4\\M_8'\\(Al''')_2\end{matrix}\right\}O_{15}$ Most uniaxial micas.	$\left.\begin{matrix}(Si^{iv})_4\\{[NaCa_2]^{iv}}\\(Al''')_4\end{matrix}\right\}O_{16},4H_2O$ Thomsonite, Comptonite.	$\left.\begin{matrix}(Si^{iv})_4\\M_6'\\(Al''')_4\end{matrix}\right\}O_{17}$ Epidote, Mejonite, &c.
		$\left[\left.\begin{matrix}(Si^{iv})_4\\M_2'\\(Al''')_2\end{matrix}\right\}O_{12}\right]^n$ Andesine.	$\left[\left.\begin{matrix}(Si^{iv})_4\\M_8'\\(Al''')_2\end{matrix}\right\}O_{15},nH_2O\right]^n$ Orthite.		$\left.\begin{matrix}(Si^{iv})_4\\M_{12}'\\(Al''')_2\end{matrix}\right\}O_{17}$ Pyro-sklerite.
		$\left.\begin{matrix}(Si^{iv})_4\\Na_2\\(Al''')_2\end{matrix}\right\}O_{12},2H_2O$ Analcime.			$\left.\begin{matrix}(Si^{iv})_4\\(SO_2'')\\Na_4\\(Al''')_4\end{matrix}\right\}O_{17}$ Nosean, &c.
		$\left.\begin{matrix}(Si^{iv})_4\\Ca_2\\(Al''')_2\end{matrix}\right\}O_{12},2H_2O$ Ledererite.			

$$\left.\begin{matrix}(Si^{iv})_4\\ Ca_2\\ (Al''')\end{matrix}\right\}O_{12},3H_2O$$

Caporcianite.

$$\left.\begin{matrix}(Si^{iv})_4\\ Ca_2\\ (Al''')_2\end{matrix}\right\}O_{12},4H_2O$$

Lomonite.

$$\left[\left.\begin{matrix}(Si^{iv})_4\\ M_2'\\ (Al''')_2\end{matrix}\right\}O_{12},6H_2O\right]^{n(=2?)}$$

Ordinary lime Chabasite, Gmelinite, &c.

$$\underbrace{\left.\begin{matrix}(Si^{iv})_4\\ [Ca_4Mg_4]\end{matrix}\right\}O_{12}\quad\left.\begin{matrix}(Si^{iv})_4\\ [Ca_4Mg_2Fe_2]\end{matrix}\right\}O_{12}}_{\text{Augite.}}$$

$$\frac{\left.\begin{matrix}(Si^{iv})_4\\ M_{12}'\\ (Al''')_4\end{matrix}\right\}O_{20},H_2O}{\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{20}}$$

Gehlenite.

$$\frac{\left.\left[\begin{matrix}\begin{pmatrix}(Si^{iv})_4\\ Na_2\\ (Al''')_2\end{pmatrix}_2^{xlviii}\\ \begin{pmatrix}(Si^{iv})_4\\ Ca_2\\ (Al''')_2\end{pmatrix}^{xxiv}\end{matrix}\right]\right\}O_{36},18H_2O}{\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{36}}$$

Soda Chabasite, or Hydrolyte.

$$\frac{\left.\begin{matrix}(Si^{iv})_{13}\\ [Mg_{12}Ca_{12}Fe_2]\\ (Al''')_2\end{matrix}\right\}O_{42}}{\left(\begin{matrix}H\\H\end{matrix}\right\}O)_{84}}=\left.\left[\begin{matrix}\underset{(Augite.)}{\begin{pmatrix}(Si^{iv})_4\\ Mg_8'\end{pmatrix}_5^{cxx}}\\ \underset{(Garnet.)}{\begin{pmatrix}(Si^{iv})_3\\ Mg_6\\ (Al''')_2\end{pmatrix}_2^{xlviii}}\end{matrix}\right]\right\}O_{84}$$

Aluminous Augite.

HYDRATES OF MULTIPLE-RADICLES, AND THEIR SALTS AND ETHERS—continued.

Multiples of Tetratomic Radicles—*continued.*

PENTASILICATES.

Derived from: $\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{11}$.

$\left.\begin{matrix}(Si^{iv})_5\\K_2\end{matrix}\right\}O_{11},14H_2O$
Crystallized silicate of potassium.

$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{14}$.

$\left.\begin{matrix}(Si^{iv})_5\\Mg_3\end{matrix}\right\}O_{14}$
Talc.

$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{18}$.

$\left.\begin{matrix}(Si^{iv})_5\\{[Mg_3,Fe]}\\(Al''')_4\end{matrix}\right\}O_{18}$.
Iolite, Dichroite, &c.

$\left.\begin{matrix}(Si^{iv})_5\\{[Ca,Mg]_4}\\(Al''')_4\end{matrix}\right\}O_{18}$
Barsowite.

$\left.\begin{matrix}(Si^{iv})_5\\{[NaCa]_4}\\(Al''')_4\end{matrix}\right\}O_{18},4H_2O$
Brevicite.

$\left.\begin{matrix}(Si^{iv})_5\\{[K,Ca,Mg,Fe]_4}\\(Al''')_4\end{matrix}\right\}O_{18},3H_2O$
Fahlunite.

$\left.\begin{matrix}(Si^{iv})_5\\{[Mg_3,Fe]}\\(Al''')_4\end{matrix}\right\}O_{18},4H_2O$
Hydrous Iolite.

$\left.\begin{matrix}(Si^{iv})_5\\Mg_4\\(Al''')_4\end{matrix}\right\}O_{18},2H_2O$
Esmarkite.

$\left.\begin{matrix}(Si^{iv})_5\\{[Na,Ca]_4}\\(Al''')_4\end{matrix}\right\}O_{18},5H_2O$
Mesol of Faröe.

HEXASILICATES.

Derived from: $\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{16}$.

$\left.\begin{matrix}(Si^{iv})_6\\K_2\\(Al''')_2\end{matrix}\right\}O_{16}$
Orthoclase.

$\left.\begin{matrix}(Si^{iv})_6\\Na_2\\(Al''')_2\end{matrix}\right\}O_{16}$
Albite.

$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{17}$.

$\left.\begin{matrix}(Si^{iv})_6\\M'_{10}\end{matrix}\right\}O_{17}$
General formula for Amphibol.

$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{18}$.

$\left.\begin{matrix}(Si^{iv})_6\\{[K_2Na_2Ca_8]}\end{matrix}\right\}O_{18},2H_2O$
Pektolite.

$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{20}$.

$\left.\begin{matrix}(Si^{iv})_6\\{[Na,Ca_3]}\\(Al''')_4\end{matrix}\right\}O_{20}$
Labradorite.

$\left(\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{21}$.

$\left.\begin{matrix}(Si^{iv})_6\\M'_{12}\\(Al''')_2\end{matrix}\right\}O_{21}$
Humboldtite, true Sarkolite.

$\left.\begin{matrix}\left(\begin{matrix}(Si^{iv})_6\\{[Ca_4Mg_4Fe_2]}\end{matrix}\right)^{xxiv}\\\left(\begin{matrix}(Al''')_2\\(Mg_2)\end{matrix}\right)^{viii}\end{matrix}\right\}O_{21}$
Spinel.
Common hornblende (Lindbo).

$\left.\begin{matrix}(Si^{iv})_6 \\ Ca_2 \\ (Al'')_2\end{matrix}\right\} O_{16}, 5H_2O$ Epistilbite.

$\left.\begin{matrix}(Si^{iv}) \\ Ca_2 \\ (Al)_2\end{matrix}\right\} O_{15}, 6H_2O$ Stillbite (Desmin).

$\left.\begin{matrix}(Si^{iv}) \\ [K_2Fe_2] \\ (Al''')_1\end{matrix}\right\} O_{20}, H_2O$ Pinite.

Derived from: $\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{25}.$

$\left.\begin{matrix}(Si^{iv})_6 \\ M'_{20} \\ (Al''')_2\end{matrix}\right\} O_{25}, 7H_2O$

Pennin.

$\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{30}.$

$\left.\begin{matrix}(Si^{iv})_6 \\ [Y_{17}G_{12}La_2Fa_5]\end{matrix}\right\} O_{30}$

Gadolinite.

$\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{66}.$

$\left.\begin{matrix}(Si^{iv})_6 \\ [Ca_{12}Mg_{24}] \\ [Fe_2'''(Al^{iv})_{23}]\end{matrix}\right\} O_{66}$

Xanthophyllite.

$\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{89}.$

$\left.\begin{matrix}\left[\left(\begin{matrix}(Si^{iv})_6 \\ [Mg,Ca,Mn,Fe]_{10}\end{matrix}\right)_5\right]^{CLXX} \\ \left[\left(\begin{matrix}(Al''')_2 \\ Mg_2\end{matrix}\right)\right]^{VIII}\end{matrix}\right\} O_{89}$

Anthophyllite.

$\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{292}.$

$\left.\begin{matrix}\left[\left(\begin{matrix}(Si^{iv})_6 \\ M'_{10}\end{matrix}\right)_{16}\right]^{DXLIV} \\ \left[\left(\begin{matrix}(Al''')_2 \\ Mg_2\end{matrix}\right)_5\right]^{LVI}\end{matrix}\right\} O_{292}$

Uralite.

—o—

HEPTASILICATES.

Derived from: $\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{30}.$

$\left.\begin{matrix}(Si^{iv})_7 \\ [Ca,Mg,Fe]_{10} \\ (Al''')_4\end{matrix}\right\} O_{30}, 6H_2O$

Chonikrite.

OCTASILICATES.

—o—

$\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{17}.$

$\left.\begin{matrix}(Si^{iv})_8 \\ K_2\end{matrix}\right\} O_{17}$

Silicate of Potassium.

$\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{25}.$

$\left.\begin{matrix}(Si^{iv})_8 \\ M'_6 \\ (Al''')_4\end{matrix}\right\} O_{25}$

Weissite or Conchoidal Triklasite.

$\left.\begin{matrix}(Si^{iv})_8 \\ Ca_6 \\ (Al''')^4\end{matrix}\right\} O_{25}, 10H_2O$

Phakolite.

$\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{35}.$

$\left.\begin{matrix}(Si^{iv})_8 \\ (SO_2'')_2 \\ [Na_2,Ca_6] \\ (Al''')_8\end{matrix}\right\} O_{35}$

Hauyn.

ENNEASILICATES.

$\left(\begin{matrix}H \\ H\end{matrix}\right\} O\Big)_{30}.$

$\left.\begin{matrix}(Si^{iv})_9 \\ [Mg_{20},Fe_4]\end{matrix}\right\} O_{30}, 3H_2O$

Antigorite.

HYDRATES OF MULTIPLE-RADICLES, AND THEIR SALTS AND ETHERS—continued.

Multiples of Tetratomic Radicles—*continued.*

XI. SILICATES.

Derived from : $\left.\begin{matrix}H\\H\end{matrix}\right\}O)_{35}$.

$\left.\begin{matrix}(Si^{iv})_{11}\\K_2\\(Al''')_8\end{matrix}\right\}O_{35},3H_2O$

Agalmatolite.

$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{37}$.

$\left.\begin{matrix}(Si^{iv})_{11}\\ [K_2,Ca_4]\\(Al''')_8\end{matrix}\right\}O_{37},15H_2O$

Gismondine, Zeagonite.

$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{42}$.

$\left.\begin{matrix}(Si^{iv})_{11}\\ [K_2,Na_8]\\(Al''')_{10}\end{matrix}\right\}O_{42}$

Nephelin, Elæolite.

$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{48}$.

$\left.\begin{matrix}(Si^{iv})_{11}\\(C^{iv})_2\\ [Na_{10},Ca_4]\\(Al''')_{10}\end{matrix}\right\}O_{48}$

Cancrinite.

XV. SILICATES.

$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{45}$.

$\left.\begin{matrix}(Si^{iv})_{15}\\M'_6\\(Al''')_8\end{matrix}\right\}O_{45}$

Oligoclase, Soda and Lithia Spodumenes, &c.

$\left.\begin{matrix}(Si^{iv})_{15}\\ [K_2,Ca_4]\\(Al''')_8\end{matrix}\right\}O_{45},18H_2O$

Potash Harmatome, Phillipsite or Lime Harmatome.

XVI. SILICATES.

Derived from : $\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{47}$.

$\left.\begin{matrix}(Si^{iv})_{16}\\Ca_6\\(Al''')_8\end{matrix}\right\}O_{47},12H_2O$

Leonhardite.

$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{60}$.

$\left.\begin{matrix}(Si^{iv})\\(Bo)_3\\ [Ca_{16},Mg_2,Mn_2,Fe_4]\\ [Fe_2'''(Al''')_7\end{matrix}\right\}O_{60}$

Axinite.

$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{66}$.

$\left.\begin{matrix}(Si^{iv})_{16}\\(SO_2'')\\ [K,Na_{10}Ca_7]\\(Al''')_{16}\end{matrix}\right\}O_{66}$

Ittnerite.

XVIII. SILICATES.

$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{51}$.

$\left.\begin{matrix}(Si^{iv})_{18}\\Ba_6\\(Al''')_8\end{matrix}\right\}O_{51},18\,H_2O$

Baryta-Harmatome.

$\left.\begin{matrix}(Si^{iv})_{18}\\ [Ba_2,Sr_3,Ca]\\(Al''')_8\end{matrix}\right\}O_{51},15H_2O$

Brewsterite.

$\left(\left.\begin{matrix}H\\H\end{matrix}\right\}O\right)_{66}$.

$\left.\begin{matrix}(Si^{iv})_{18}\\ [K_5,Fe]\\ [Fe'''(Al''')_{17}]\end{matrix}\right\}O_{66}=\left[\left.\begin{matrix}(Si^{iv})_3\\M'\\(M''')_3\end{matrix}\right\}O_{11}\right]^n$

Biaxial Mica.

XXI. SILICATES.

Derived from: $\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{57}.$

$$\left.\begin{matrix}(Si^{iv})_{21}\\ Ca_6\\ (Al''')_8\end{matrix}\right\}O_{57},20H_2O$$

Heulandite.

XXIV. SILICATES.

$\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{49}.$

$$\left.\begin{matrix}(Si^{iv})_{24}\\ K_2\end{matrix}\right\}O_{49},16H_2O$$

Silicate of potassium.

XXX. SILICATES.

$\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{75}.$

$$\left.\begin{matrix}(Si^{iv})_{30}\\ [Na_2Li_4]\\ (Al''')_8\end{matrix}\right\}O_{75}$$

Petalite.

LXXII. SILICATES.

Derived from: $\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{312}.$

$$\left.\begin{matrix}(Si^{iv})_{72}\\ (Bo)_6\\ [K_6Li_6Mn_6Fe_6]_{xxiv}\\ [(Fe_2''')_6(Al''')_{90}]_{xcvi}\end{matrix}\right\}O_{312}$$

Tourmaline (Brazil).

$\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{318}.$

$$\left.\begin{matrix}(Si^{iv})_{72}\\ (Bo)_6\\ [K_3,Li_{18}Mn_{15}]_{xxxvi}\\ (Al''')_{96}\end{matrix}\right\}O_{318}$$

Tourmaline (Perm).

$$\left.\begin{matrix}(Si^{iv})_{72}\\ (Bo)_6\\ [Na_{18}Mn_9Fe_9]_{xxxvi}\\ [(Fe_2''')_9(Al''')_{87}]_{xcvi}\end{matrix}\right\}O_{318}$$

Tourmaline (Chesterfield).

$\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{324}.$

$$\left.\begin{matrix}(Si^{iv})_{72}\\ (Bo)_6\\ [Na_{12}Mg_{36}]_{xlviii}\\ [(Fe''')_9(Al''')_{87}]_{xcvi}\end{matrix}\right\}O_{324}$$

Tourmaline (Greenland).

$\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{326}.$

$$\left.\begin{matrix}(Si^{iv})_{72}\\ (Bo)_6\\ [Na_9Mg_{27}Mn_6Fe_{10}]_{lii}\\ [(Fe_2''')_{12}(Al''')_{84}]_{xcvi}\end{matrix}\right\}O_{326}$$

Tourmaline (Rabenstein).

$\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{336}.$

$$\left.\begin{matrix}(Si^{iv})_{72}\\ (Bo)_6\\ [Na_8Mg_{64}]_{lxxii}\\ [(Fe''')_{16}(Al''')_{80}]_{xcvi}\end{matrix}\right\}O_{336}$$

Tourmaline (Karingbricka).

$\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{340}.$

$$\left.\begin{matrix}(Si^{iv})_{72}\\ (Bo)_8\,(?)\\ [Na_8Ca_4Mg_4Fe_{56}]_{lxxii}\\ [(Fe''')_8(Al''')_{88}]_{xcvi}\end{matrix}\right\}O_{340}$$

Tourmaline (Bovey).

$\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{348}.$

$$\left.\begin{matrix}(Si^{iv})_{72}\\ (Bo)_6\\ [Na_{12}Fe_{84}]_{xcvi}\\ (Al''')_{96}\end{matrix}\right\}O_{348}$$

Tourmaline (Eibenstock).

$\Big(\left.\begin{matrix}H\\H\end{matrix}\right\}O\Big)_{288}.$

$$\left.\begin{matrix}(Si^{iv})_{72}\\ (Bo)_6\\ [K_6Li_{18}Ca_6Mn_{18}]_{xlviii}\\ (Al''')_{72}\end{matrix}\right\}O_{288}$$

Tourmaline (Rozna).

CHLORHYDRIC ACID—WATER TYPE.

TRISILICATES.

$$\left.\begin{array}{l}(Si^{iv})_3\\(Al''')_6\end{array}\right\}\begin{array}{l}F_4\\O_{13}\end{array}$$

Topas.

$$\left.\begin{array}{l}(Si^{iv})_3\\M'_{16}\end{array}\right\}\begin{array}{l}F_2\\O_{13}\end{array}$$

Chondrodite.

TETRASILICATES.

$$\left.\begin{array}{l}(Si^{iv})_4\\(Al''')_6\end{array}\right\}\begin{array}{l}F_4\\O_{15}\end{array}$$

Pyknite.

PENTASILICATES.

$$\left.\begin{array}{l}(Si^{iv})_5\\{[Ca_6Ci_6Na_2]}\end{array}\right\}\begin{array}{l}F_2\\O_{16}\end{array}$$

Leukophan.

ENNEASILICATES.

$$\left.\begin{array}{l}(Si^{iv})_9\\{[K_2Li_4]}\\(Al''')_6\end{array}\right\}\begin{array}{l}(F,Cl)_6\\O_{27}\end{array} = \left[\left.\begin{array}{l}(Si^{iv})_3\\M''_2\\(Al_2''')_2\end{array}\right\}\begin{array}{l}(F,Cl)_2\\O_9\end{array}\right]^n$$

Lepidolite.

HEXASILICATES.

$$\left.\begin{array}{l}(Si^{iv})_6\\Na_8\\(Al''')_6\end{array}\right\}\begin{array}{l}Cl_2\\O_{24}\end{array}$$

Sodalite.

$$\left.\left[\begin{array}{l}(Si^{iv})_6\\{[NaCa_3]}\\(Al''')_4\end{array}\right]_2^{lxxx}\right\}\begin{array}{l}Cl_2\\O_{39}\end{array}$$

Porcelain spar.

$$\left.\begin{array}{l}\left(\begin{array}{l}(Si^{iv})_6\\{[Ca_8,Mg_7]_{10}}\\\textit{(Amphibol.)}\end{array}\right)_4^{cxxxvi}\\Mg_2\end{array}\right\}\begin{array}{l}F_2\\O_{68}\end{array}$$

Tremolite.

$$\left.\left(\begin{array}{l}(Si^{iv})_6\\{[Ca,Mg,Fe]_{10}}\end{array}\right)_{10}^{cccxl}\right\}\begin{array}{l}F_2\\O_{160}\end{array}$$

Asbestos.

$$\left.\begin{array}{l}\left(\begin{array}{l}(Si^{iv})_6\\{[Ca,Mg,Fe]_{10}}\\\textit{(Amphibol.)}\end{array}\right)_{14}^{ccoclxxvi}\\\left(\begin{array}{l}(Al''')_2\\Mg_2\\\textit{(Spinel.)}\end{array}\right)_7^{lvi}\end{array}\right\}\begin{array}{l}F_4\\O_{206}\end{array}$$

Common Hornblende
(Nordmark.)

$$\left.\begin{array}{l}\left(\begin{array}{l}(Si^{iv})_6\\M'_{10}\\\textit{(Amphibol.)}\end{array}\right)_{14}^{ccoclxxvi}\\\left(\begin{array}{l}(Al''')_2\\Mg_2\\\textit{(Spinel.)}\end{array}\right)_{15}^{cxx}\\Mg_{10}\end{array}\right\}\begin{array}{l}F_{10}\\O_{298}\end{array}$$

Grammatite.
(Aker.)

XV. SILICATES.

$$\left.\begin{array}{l}(Si^{iv})_{15}\\{[K_2Ca_{16}]}\end{array}\right\}\begin{array}{l}F_2\\O_{38}\end{array}$$

Apophyllite.

AMMONIA, OR TRIATOMIC TYPE.

Classes of bodies referable to this type:—Basylous, chlorous, and neutral nitrides (amines and amides), phosphides, arsenides, and stibides.

CHLOROUS, OR NEGATIVE SERIES.

A. Monamides, Monophosphides, Monarsides, and Monostibides.

a. Primary.

$\left.\begin{matrix}C_2H_3O\\H\\H\end{matrix}\right\}N$ Acetamide.

$\left.\begin{matrix}C_9H_7O\\H\\H\end{matrix}\right\}N$ Cinnamide.

$\left.\begin{matrix}C_7H_5S\\H\\H\end{matrix}\right\}N$ Thiobenzamide.

$\left.\begin{matrix}C_2Cl_3O\\H\\H\end{matrix}\right\}N$ Chloracetamide.

$\left.\begin{matrix}CN\\H\\H\end{matrix}\right\}N$ Cyanamide.

$\left.\begin{matrix}C_7H_3(NO_2)^2O\\H\\H\end{matrix}\right\}N$ Dinitrobenzamide.

β. Secondary.

$\left.\begin{matrix}C_2H_3O\\C_2H_3O\\H\end{matrix}\right\}N$ Biacetamide.

$\left.\begin{matrix}(C_5H_4O_2)''\\H\end{matrix}\right\}N$ Citraconimide.

$\left.\begin{matrix}SO_2''\\H\end{matrix}\right\}N$ Sulphamide (sulphimide).

INTERMEDIATE SERIES.

$\left.\begin{matrix}C_2H_3O\\C_2H_5\\H\end{matrix}\right\}N$ Ethylacetamide.

$\left.\begin{matrix}CN\\CH_3\\H\end{matrix}\right\}N$ Methyl-cyanamide.

BASYLOUS, OR POSITIVE SERIES.

A. Monamines, Monophosphines, Monarsines, Monostibines.

a. Primary.

$\left.\begin{matrix}K\\H\\H\end{matrix}\right\}N$ Potassamine.

$\left.\begin{matrix}CH_3\\H\\H\end{matrix}\right\}N$ Methylamine.

$\left.\begin{matrix}C_6H_5\\H\\H\end{matrix}\right\}N$ Phenylamine (aniline).

$\left.\begin{matrix}Z\\H\\H\end{matrix}\right\}N$ Zincamine.

$\left.\begin{matrix}C_2H_5\\H\\H\end{matrix}\right\}N$ Ethylamine.

β. Secondary.

$\left.\begin{matrix}CH_3\\CH_3\\H\end{matrix}\right\}N$ Bimethylamine.

$\left.\begin{matrix}C_2H_5\\C_5H_{11}\\H\end{matrix}\right\}N$ Ethylamylamine.

AMMONIA, OR TRIATOMIC TYPE—continued.

Chlorous, or Negative Series.

A. Monamides, Monophosphides, Monarsides, and Monostibides—*continued.*

$\left.\begin{matrix}(C_4H_2O_2)'' \\ H\end{matrix}\right\} N$
Fumarimide.

γ. Tertiary.

$\left.\begin{matrix}C_2H_3O \\ C_2H_3O \\ C_2H_3O\end{matrix}\right\} N$
Triacetamide.

$(PO)''' \} N$
Monophosamide (biphosphamide).

Intermediate Series.

$\left.\begin{matrix}CHO \\ C_{10}H_7 \\ H\end{matrix}\right\} N$
Naphthylformamide.

$\left.\begin{matrix}C_2H_3O \\ Zn \\ H\end{matrix}\right\} N$
Zinc-acetamide.

$\left.\begin{matrix}C_7H_5O \\ Hg \\ H\end{matrix}\right\} N$
Benzamidate of mercury.

$\left.\begin{matrix}C_2H_3O \\ C_2H_3O \\ C_2H_5\end{matrix}\right\} N$
Ethylbiacetamide.

$\left.\begin{matrix}CN \\ CH_3 \\ C_2H_5\end{matrix}\right\} N$
Methyl-ethyl-cyanamide.

$\left.\begin{matrix}(C_5H_4O_2)'' \\ C_6H_5\end{matrix}\right\} N$
Phenylcitraconimide.

Basylous, or Positive Series.

A. Monamines, Monophosphines, Monarsines, Monostibines—*continued.*

$\left.\begin{matrix}C_2H_5 \\ C_2H_5 \\ H\end{matrix}\right\} N$
Biethylamine.

$\left.\begin{matrix}C_2H_5 \\ C_6H_5 \\ H\end{matrix}\right\} N$
Ethylphenylamine.

γ. Tertiary.

$\left.\begin{matrix}K \\ K \\ K\end{matrix}\right\} N$
Nitride of potassium.

$\left.\begin{matrix}Cu_2 \\ Cu_2 \\ Cu_2\end{matrix}\right\} As$
Arsenide of copper.

$\left.\begin{matrix}CH_3 \\ CH_3 \\ CH_3\end{matrix}\right\} N$
Trimethylamine.

$\left.\begin{matrix}C_2H_5 \\ C_2H_5 \\ C_2H_5\end{matrix}\right\} As$
Triethylarsine.

$\left.\begin{matrix}Hg \\ Hg \\ Hg\end{matrix}\right\} N$
Nitride of mercury.

$\left.\begin{matrix}Ag \\ Ag \\ Ag\end{matrix}\right\} Sb$
Stibide of silver.

$\left.\begin{matrix}CH_3 \\ C_2H_5 \\ C_5H_{11}\end{matrix}\right\} N$
Methyl-ethyl-amylamine.

$\left.\begin{matrix}C_5H_{11} \\ C_5H_{11} \\ C_5H_{11}\end{matrix}\right\} Sb$
Triamylstibine.

B'. Diamides, Diphosphides.

a. Primary.

$\left.\begin{matrix}SO_2''\\H_2\\H_2\end{matrix}\right\}N_2$ Sulpho-diamide (Sulph-amide).

$\left.\begin{matrix}(CO)''\\H_2\\H_2\end{matrix}\right\}N_2$ Carbamide (urea).

$\left.\begin{matrix}(C_2O_2)''\\H_2\\H_2\end{matrix}\right\}N_2$ Oxamide.

$\left.\begin{matrix}PO'''\\H_3\end{matrix}\right\}N_2$ Phospho-diamide.

$\left.\begin{matrix}(C_4H_4O_2)''\\H_2\\H_2\end{matrix}\right\}N_2$ Succinamide.

$\left.\begin{matrix}(C_5H_4O_2)''\\H_2\\H_2\end{matrix}\right\}N_2$ Citracona-mide.

$\left.\begin{matrix}(CN)_2\\H_2\\H_2\end{matrix}\right\}N_2$ Dicyano-diamide.

$\left.\begin{matrix}Co\\Co\\Co\end{matrix}\right\}N$ Nitride of cobalt.

$\left.\begin{matrix}C_2H_5\\C_2H_5\\Zn\end{matrix}\right\}N$ Zinc-biethyl-amine.

$\left.\begin{matrix}CH_3\\CH_3\\CH_3\end{matrix}\right\}P$ Triethyl-phos-phine.

B. Diamines, Diphosphines, &c.

a. Primary.

$\left.\begin{matrix}C_2H_4''\\H_2\\H_2\end{matrix}\right\}N_2$ Ethylene-amine

$\left.\begin{matrix}(C_{12}H_8)''\\H_2\\H_2\end{matrix}\right\}N_2$ Benzidine

AMMONIA, OR TRIATOMIC TYPE—continued.

Chlorous, or Negative Series.		Intermediate Series.		Basylous, or Positive Series.	
B. Diamides, Diphosphides—*continued.*				**B. Diamines, Diphosphines, &c.**—*continued.*	
β. Secondary.				*β. Secondary.*	
$\left.\begin{matrix}(CO)''\\ C_2H_3O,H\\ H_2\end{matrix}\right\}N_2$ Acetyl-urea.	$\left.\begin{matrix}(CO)''\\ C_7H_5O,H\\ H_2\end{matrix}\right\}N_2$ Benzoyl-urea.	$\left.\begin{matrix}(CO)''\\ CH_3,H\\ H_2\end{matrix}\right\}N_2$ Monomethyl-urea.	$\left.\begin{matrix}(C_2O_2)''\\ (CH_3)^2\\ H_2\end{matrix}\right\}N_2$ Dimethyl-oxamide.	$\left.\begin{matrix}C_2H_4''\\ C_2H_4''\\ H_2\end{matrix}\right\}N_2$ Diethylene-amine.	$\left.\begin{matrix}C_2H_4''\\ (C_2H_5)_2\\ H_2\end{matrix}\right\}N_2$ Ethylene-diethyl-amine.
		$\left.\begin{matrix}(CO)''\\ (C_6H_5)^2\\ H_2\end{matrix}\right\}N_2$ Diphenyl-urea.	$\left.\begin{matrix}(C_2O_2)''\\ (C_{10}H_7)^2\\ H_2\end{matrix}\right\}N_2$ Dinaphthyloxa-mide.		
		$\left.\begin{matrix}(CS)''\\ (C_6H_5)^2\\ H_2\end{matrix}\right\}N_2$ Diphenyl-sulpho-carbamide.	$\left.\begin{matrix}(C_2O_2)''\\ Zn_2\\ H_2\end{matrix}\right\}N_2$ Di-zinc-oxamide.		

γ. Tertiary.

$\left.\begin{matrix}C_4H_4O_2{}'' \\ C_4H_4O_2{}'' \\ C_4H_4O_2{}''\end{matrix}\right\}N_2$
Trisuccindiamide.

$\left.\begin{matrix}(C_4H_4O_2)'' \\ (C_7H_5O')_2 \\ (C_6H_5SO_2)_2\end{matrix}\right\}N_2$
Bibenzoyl-bisulpho-phenyl-succindiamide.

$\left.\begin{matrix}(CO)'' \\ C_2H_5,H \\ (C_5H_{11})_2\end{matrix}\right\}N_2$
Monethyl-diamyl carbamide (monethyl-biamyl-urea).

$\left.\begin{matrix}(CO)'' \\ (C_2O_2)'' \\ (C_6H_5)_2\end{matrix}\right\}N_2$
Diphenyl oxcarbamide.

$\left.\begin{matrix}(C_7H_6O)'' \\ (C_7H_6O)'' \\ (C_7H_6O)''\end{matrix}\right\}N_2$
Hydrosalicylamide.

C. Triamides, Triphosphides, &c.

$\left.\begin{matrix}Cy_3 \\ H_3 \\ H_3\end{matrix}\right\}N_3$
Cyanuramide (melamine).

$\left.\begin{matrix}(C_6H_5O_4)''' \\ H_3 \\ H_3\end{matrix}\right\}N_3$
Citramide.

$\left.\begin{matrix}(C_6H_5O_4)''' \\ (C_6H_5)^2,H \\ H_3\end{matrix}\right\}N_3$
Diphenylcitramide.

$\left.\begin{matrix}PO''' \\ H_3 \\ H_3\end{matrix}\right\}N_3$
Phospho-triamide.

$\left.\begin{matrix}(PS)''' \\ H_3 \\ H_3\end{matrix}\right\}N_3$
Sulphospho-triamide.

γ. Tertiary.

$\left.\begin{matrix}C_2H_4{}'' \\ C_2H_4{}'' \\ C_2H_4{}''\end{matrix}\right\}N_2$
Triethylene-amine.

C. Triamines, Triphosphines, &c.

$\left.\begin{matrix}C^{iv} \\ (C_2H_5)^3 \\ H_2\end{matrix}\right\}N_3$
Triethylcarbo-triamine (triethylcyano-diamine).

$\left.\begin{matrix}C^{iv} \\ (C_6H_5)^3 \\ H_2\end{matrix}\right\}N_3$
Triphenylcarl o-triamine.

$\left.\begin{matrix}C_3H_5{}''' \\ C_3H_5{}''' \\ C_3H_5{}'''\end{matrix}\right\}N_3$
Cyanethine.

$\left.\begin{matrix}C^{iv} \\ H_5\end{matrix}\right\}N_3$
Carbo-triamine (or cyandiamine).

AMMONIA, OR TRIATOMIC TYPE—continued.

Chlorous, or Negative Series.	Intermediate Series.	Basylous, or Positive Series.
D. Tetramides, Tetraphosphides, &c.		**D. Tetramines, Tetraphosphines, &c.**
		$\left.\begin{matrix}C_2H_2''''\\C_2H_2''''\\C_2H_2''''\end{matrix}\right\}N_4$ Glycosine.

MIXED TYPES.

A. Chlorhydric Acid—Water Type.

Biatomic.

$\left.\begin{matrix}C_2H_4''\\H\end{matrix}\right\}\begin{matrix}O\\Cl\end{matrix}$ Glycollic chlorhydrin.

$\left.\begin{matrix}C_2H_4''\\(C_4H_7O)'\end{matrix}\right\}\begin{matrix}O\\I\end{matrix}$ Glycollic iodbutyrin.

Triatomic.

$\left.\begin{matrix}C_3H_5'''\\H_2\end{matrix}\right\}\begin{matrix}O_2\\Cl\end{matrix}$ Monochlorhydrin.

$\left.\begin{matrix}C_3H_5'''\\H\end{matrix}\right\}\begin{matrix}O\\Cl_2\end{matrix}$ Dichlorhydrin.

$\left.\begin{matrix}C_3H_5'''\\(C_2H_3O')\\H\end{matrix}\right\}\begin{matrix}O\\Cl\end{matrix}$ Acetochlorhydrin.

$\left.\begin{matrix}C_3H_5'''\\(C_2H_3O')_2\end{matrix}\right\}\begin{matrix}O\\Cl_2\end{matrix}$ Acetodichlorhydrin.

$\left.\begin{matrix}C_3H_5'''\\(C_2H_5)_2\end{matrix}\right\}\begin{matrix}O_2\\Cl\end{matrix}$ Diethylchlorhydrin.

$\begin{matrix}C_3H_5'''\\C_2H_5\end{matrix}\left\{\begin{matrix}Cl\\O\\Br\end{matrix}\right.$ Ethylchlorobromhydrin.

Meta- and Multiple Radical bodies.

$\left.\begin{matrix}(C_3H_5''')_2\\(C_2H_5)_2\\H\end{matrix}\right\}\begin{matrix}O_4\\Cl\end{matrix}$ Chlorhydro-diethyl-diglycerin.

$\left.\begin{matrix}(C_3H_5)'''_2\\H\end{matrix}\right\}\begin{matrix}I\\O_3\end{matrix}$ Iodhydrodiglycide (Berthelot's Iodhydrin).

$\left.\begin{matrix}C_6H_8^{vi}\\H_2\end{matrix}\right\}\begin{matrix}O_3\\Cl_2\end{matrix}$ Chlorhydromannitan.

B. Water—Ammonia Type.

A. Amic Acids, Hydoramides.

a. Monamic Acids.

$N\left\{\begin{matrix} SO_2'' \\ H_2 \\ H \end{matrix}\right\}O$ Sulphamic acid.

$N\left\{\begin{matrix} (PO)''' \\ H \\ H \end{matrix}\right\}O$ Phosphamic acid.

$N\left\{\begin{matrix} (C_2O_2)'' \\ H_2 \\ H \end{matrix}\right\}O$ Oxamic acid.

$N\left\{\begin{matrix} (C_2O_2'') \\ C_2H_5 \\ H \\ H \end{matrix}\right\}O$ Ethyloxamic acid.

$N\left\{\begin{matrix} (C_6H_5O''') \\ C_6H_5' \\ H \end{matrix}\right\}O$ Phenylcitramic acid.

$N\left\{\begin{matrix} (C_2H_2O)'' \\ H \quad H \\ H \end{matrix}\right\}O$ Glycollamic acid, *Monobasic* (Glycocine).

$N\left\{\begin{matrix} (C_2H_2O)'' \\ H \\ (C_2H_2O)'' \\ H \\ H \end{matrix}\right. \begin{matrix} \}O \\ \\ \}O \end{matrix}$ Diglycollamic acid, *Bibasic*.

$N\left\{\begin{matrix} (C_2H_2O)'' \\ H \\ (C_2H_2O)'' \\ H \\ (C_2H_2O)'' \\ H \end{matrix}\right. \begin{matrix} \}O \\ \\ \}O \\ \\ \}O \end{matrix}$ Triglycollamic acid, *Tribasic*.

$N\left\{\begin{matrix} (C_2H_2O)'' \\ C_7H_5O \\ H \\ H \end{matrix}\right\}O$ Hippuric acid.

$N\left\{\begin{matrix} (CN)_3 \\ H_2 \\ H_2 \end{matrix}\right\}O_2$ Melanurenic acid.

$N\left\{\begin{matrix} (CN)_6 \\ H_3 \end{matrix}\right\}O_3$ Cyameluric acid.

A. Ammoniums and Hydoramines.

a. Monammoniums, &c.

$\left.\begin{matrix} N(C_2H_5)^4 \\ H \end{matrix}\right\}O$ Hydrate of tetrethylium.

$\left.\begin{matrix} N(CH_3,C_2H_5,C_5H_{11},C_6H_5) \\ H \end{matrix}\right\}O$ Hydrate of methyl-ethyl-amyl-phenylium.

$\left.\begin{matrix} N,(CH_3,C_2H_5,C_8H_{14}) \\ H \end{matrix}\right\}O$ Hydrate of ethyl-methyl coninium.

$\left.\begin{matrix} P(C_2H_5)^4 \\ H \end{matrix}\right\}O$ Hydrate of tetrethyl-phosphonium.

$\left.\begin{matrix} As(C_2H_5)^4 \\ H \end{matrix}\right\}O$ Hydrate of tetrethyl-arsonium.

$\left.\begin{matrix} Sb(CH_3)^4 \\ H \end{matrix}\right\}O$ Hydrate of tetra-methyl-stibonium.

$\left.\begin{matrix} C_3H_5''' \\ H_4 \end{matrix}\right\}\begin{matrix} N \\ O_2 \end{matrix}$ Glyceramine.

MIXED TYPES—continued.

B. Water—Ammonia Type.

A. Amic Acids, Hydoramides—*continued.*

β. Diamic Acids.

$$N_2\left\{\begin{matrix}(PO)''' \\ H \\ H_4\end{matrix}\right.\left.\begin{matrix} \\ \end{matrix}\right\}O$$

Phosphodiamic acid.

$$N_2\left\{\begin{matrix}(C_6H_5O)''' \\ (C_6H_5)_2\ H \\ H_2\end{matrix}\right.\left.\begin{matrix} \\ \end{matrix}\right\}O$$

Diphenylcitradiamic acid.

A. Ammoniums and Hydoramines—*continued.*

β. Diammoniums, &c.

$$\left.\begin{matrix}P_2(C_2H_5)_6(C_2H_4)'' \\ H_2\end{matrix}\right\}O_2$$

Hydrate of ethylene-hexethyl-diphosphonium.

$$\left.\begin{matrix}NP(C_2H_5)_3(C_2H_4)''H_3 \\ H_2\end{matrix}\right\}O_2$$

Hydrate of ethylene-triethyl-phosphammonium.

$$\left.\begin{matrix}NAs(C_2H_5)^3(C_2H_4)''H_3 \\ H_2\end{matrix}\right\}O_2$$

Hydrate of ethylene-triethyl-arsammonium.

$$\left.\begin{matrix}PAs(C_2H_5)^6(C_2H_4)'' \\ H_2\end{matrix}\right\}O_2$$

Hydrate of ethylene-hexethyl-phospharsonium.

$$\left.\begin{matrix}CN \\ (C_2H_2O)'' \\ CH_3 \\ H_4\end{matrix}\right\}\begin{matrix}N_3 \\ O\end{matrix}$$

Creatine.

$$\left.\begin{matrix}(CN)_3 \\ H_2 \\ H_3\end{matrix}\right\}\begin{matrix}N_2 \\ O\end{matrix}$$

Ammeline.

C. Chlorhydric Acid—Water—Ammonia Type.

$$\left.\begin{matrix}C_3H_5''' \\ C_3H_5''' \\ H_2\end{matrix}\right\}\begin{matrix}N \\ O_2 \\ Cl\end{matrix}$$

Diglyceryl-dihydor-chloramine, or Hemichlorhydramide.

$$\left.\begin{matrix}(C_3H_5)''' \\ (C_3H_5)''' \\ H_2\end{matrix}\right\}\begin{matrix}N \\ O_2 \\ Br\end{matrix}$$

Diglyceryl-dihydor-bromamine.

PHYSICAL CHEMISTRY.

CRYSTALLOLOGY.

I. CRYSTALLOGRAPHY.

Generalities.—Of crystals. Faces; kinds of faces which occur in natural crystals; simple and compound forms; dominant and secondary forms. Edges; kinds of edges. Angles; kinds of angles. Rule for determining the number of faces, edges, and angles of a form.

Axes; kinds of axes—co-ordinate axes, morphological axes, crystallographic axes. Upright position of a crystal. Principal and secondary crystallographic axes. Sections; principal sections; projections. Classification of the morphological axes of forms, according to the relative symmetry of the principal sections of the different systems of axes.

Principal types of form; uniaxial and polyaxial forms; comparative symmetry of forms. Relations between the different forms which the same substance may assume; derivation—truncation and pointing of angles—truncation and bevelment of edges; alternate or diagonal positions. Law of symmetry; progression; zones. Exception to the law of symmetry—hemihedrism. Anomalies of symmetry—twin crystals; hemitropes, cruciform, macles, and circular macles.

Relation of the faces of a crystal to its crystallographic axes—parameters. Law of multiple proportion observed between the parameters of the series of faces which occur in the forms assumed by any given body; indices. Notation of faces.

Classification.—Classification of crystalline forms into seven systems according to the number, angles of intersection, and relative lengths of the crystallographic axes.

I. TRIMETRICAL,

(or forms in which three crystallographic axes are assumed).

A. Orthohedric,

(or straight forms, the axes of which intersect at right angles).

1. Isometrical (monometrical, cubical, octohedral, or regular).
2. Monodimetric (tetragonal, quadratic, prismatic, or pyramidal).
3. Anisometric (trimetric, orthorhombic, or rhombic).

B. Clinohedric.

(or leaning forms, with one or more axes intersecting at oblique angles).

4. Monoclinic, or singly leaning prismatic system. (Augitic, clinorhombic or oblique prismatic system).

5. Diclinic, or doubly leaning prismatic system (diclinrhombic system).

6. Triclinic, or trebly leaning prismatic system (anorthic or doubly oblique prismatic system).

II. TETRAMETRICAL;

(or forms in which four crystallographic axes are assumed).

7. HEXAGONAL or RHOMBOHEDRAL system.

DESCRIPTION.—Character of the axes of each system; fundamental form and progression of each system. Simple holohedral and hemihedral forms of each system. Derivation of the simple forms from the respective fundamental forms of each system: *a.* by truncatures on the angles; *b.* by truncatures on the edges; *c.* by bevelment of the edges; and *d.* by pointing of the angles.

Homogeneous combinations, or compounds of two simple forms; heterogeneous or mixed combinations.

Twins of each system: *a.* hemitropes; *b.* cruciform macles; *c.* circular macles.

II. CRYSTALLO-PHYSICS.

DENSITY.—Comparative density of bodies in different states. Relation between crystalline form and density.

COHESION.—Cleavage; origin of the word; the facility of cleavage not equal in every direction; secondary cleavages; relation between the crystalline system and the number and relative facilities of cleavages; solid of cleavage.

Hardness; scales of hardness; relative hardness of the different faces of compound forms, and of the different faces of cleavage. Action of solvents on the faces of crystals.

Fracture of crystals, and of crystalline bodies.

OPTICAL PROPERTIES.—Transparency. Simple refraction; index of refraction; dispersive power of crystals. Double refraction in crystals; relative position of the two images; law followed by the ordinary ray. Relation between the crystalline form and double refraction—crystals with one optic axis; position of the axis in uniaxial crystals; position of the axes in biaxial crystals. Positive and negative double refraction; measure of the angle between the optic axes,

Polarization of light by reflection; angle of polarization in different crystals; analogy between double refraction and polarization. Polarization of light by the tourmaline; use of the tourmaline to discover the existence of a double refractive power in crystals. Black lines and coloured rings seen in crystals by polarized light. Relation between the black lines and coloured rings and the crystalline form; use of the relative diameters of coloured rings to distinguish hemitropes. Rotatory polarization in quartz; relation between the rotatory power and hemihedrism. Hyperbolic fringes of M. Delezenne. Pasteur's observations on the relation between rotatory polarization and the dissymmetry of tartaric acid.

Lamellar polarization; explanation which it affords of certain phenomena of polarization in the regular system, and of the apparent existence of two axes in certain uniaxial crystals.

Lustre; kinds of lustre; degrees of lustre. Colour; scales of colour employed in the description of bodies. Streak. Opalescence, Fluorescence, Irisation, Asteries, Polychroism.

Elasticity.—Elastic properties of crystals discovered by means of vibration of plates; disposition of the nodal lines. Relation between the crystalline form and elasticity—axes of elasticity. Comparative acoustic properties of the crystals of each system.

Thermal Properties.—Influence of crystalline form upon specific and latent heat. Influence of crystalline form upon the relative power of conducting heat in different directions. Expansion of crystals. Grailich's law of conservation of zones.

Propagation of radiant heat in crystals.

Electrical and Magnetical Relations of Crystals.—Development of electricity in crystals; classification of crystalline bodies into positive and negative according as they produce one or the other kind of electricity. Polar electricity of crystals; electrical axes; terminal and central poles of electrical axes. Influence of form upon electrical conductibility.

Phosphorescence of crystalline bodies.

Magnetic polarity of certain minerals; relation between magnetic polarity and crystalline form. Diamagnetic properties of certain crystals.

III. CRYSTALLO-CHEMISTRY.

Influence of chemical composition upon the symmetry of form of bodies. Crystalline forms of the simple bodies. Crystallo-chemical classification of compound bodies.

Heteromorphism, dimorphism, trimorphism. Isomorphism, homæomorphism, isomeromorphism, heteromeric isomorphism, polymeric isomorphism. Comparison between the indices of crystalline series of isomorphic groups.

IV. CRYSTALLOGENY.

Methods by which crystals may be formed. 1. By the wet way, that is, by solution of the substance in water, or other fluid. 2. By the dry way—*a.* by simple fusion and cooling; *b.* by the agency of fluxes; *c.* by direct sublimation, by indirect sublimation, or by transport; and *d.* by internal molecular changes induced by heat, vibration, &c.

Imperfections of crystals: unequal extension of faces, monstrosities, obliterations, imperfections of surface, striae. Twins:

metagenic and paragenic twins. Combinations of heterogeneous crystals; paragenesis of heterogeneous crystals.

Growth of crystals, size of crystals, structure of crystalline groups. When the growth is uniform or normal in all three dimensions, the structure of aggregated masses of crystals is granular (saccharoidal, &c.); when the growth is chiefly according to two dimensions, the structure is lamellar (orthoclase, sparry, scaly, schistoid, &c.); when the growth is chiefly according to one dimension, the structure is baccillary or fibrous (acicular, radiated, felted, &c.).

Circumstances which influence the production, growth, or form of crystals. Density of solution, compression, mass of solution or melted matter, vibration; form of vessel, action of crystals of the same kind or of a different kind; action of light; evaporation, temperature of dissolution, joint action of pressure and temperature; presence of isomorphic salts having analogous composition; isomorphic compounds of a different chemical composition; presence of clinic compounds in the mother liquors of orthically crystallizing bodies, and conversely of orthic compounds in those of clinically crystallizing bodies; voltaic currents; action of magnetism.

Nature of crystallizing force. The crystalline state the normal condition of solid matter; the amorphous and glassy states, as well as the state of temper in steel, &c., are states of tension. Proofs of the correctness of this view afforded by the processes of devitrification, metamorphism of rocks by heat without fusion, effects of long-continued vibration upon bars of metal, &c.

Views regarding the molecular constitution of matter. The crystalline molecules not necessarily identical with the ultimate molecules; they are rather to be considered as proximate compounds of ultimate particles in much the same way as the proximate constituents of animals and plants are each made up of certain ultimate particles. Haüy's theory of decrements. Application of this theory to account for the modification of crystals: decrements on the edges; decrements on the angles; mixed decrements. External isomorphism does not necessarily involve identity of integrant or crystalline molecules. A substance may even have two distinct integrant molecules, one of which is intimately connected with the chemical constitution of the body, while the other merely belongs to it in its crystallized state. The circumstance that a substance may exhibit the phenomenon of circular polarization in the solid state, and not in solution, supports this view. Delafosse's use of the preceding doctrine to explain hemihedrism. Causes which appear to produce this kind of dissymmetry.

Pseudomorphites or imitative forms—*a*. those formed by the loss of one or more constituents; *b*. those formed by the gain of one or more constituents; *c*. those formed by the removal and addition of constituents; *d*. those formed by a total substitution of material.

Comparison between the artificial methods of producing crystals, and those by which it would appear that natural ones have been formed.

History of Crystallography.—The predecessors of Haüy—Gulielmini, Bergmann, Romé Delisle. Crystallographic system of Haüy. Weiss' introduction of the mode of considering crystals in reference to their axes, and his theory of hemihedrism. Different systems of nomenclature which have been proposed.

THERMO-CHEMISTRY.

Influence of chemical composition upon the dilatation of solids and liquids. Changes of density which accompany chemical changes. Maximum density of saline solutions.

Fusion and solidification. Ebullition and evaporation; distillation and sublimation; distinction between gases and vapours. Relation between the boiling points of homologous series. Influence of salts in solution upon the boiling point of liquids; boiling point of saturated solutions; freezing point of saline solutions. Latent heat of fusion; latent heat of gases; latent heat of solution, and of dilution; relation between the chemical composition of a body and its latent fusion and evaporation heat. Relation between the density of gases and vapours and their chemical equivalent. Tension of vapours at different temperatures; tension of the vapour of mixed fluids; tension of the vapour of saline solutions; influence which the addition of a salt to a mixture of two fluids exerts upon the tension of the vapour.

Specific heat of bodies; relation established between the specific heat and chemical equivalents of bodies.

Heat of combination. Thermo-chemical laws.

Calorimetry. Different methods employed to determine the specific, latent, and combination heat of bodies.

Theories of combustion. Nature of flame.

Chemical relations of radiant heat.

CHEMICAL RELATIONS OF LIGHT.

Combinations and decompositions affected by the aid of light. Molecular changes induced in bodies by the action of light, and by which their chemical properties are altered. The photographic image. Chemical effects of the different coloured rays of the solar spectrum. Effects of solutions of

different substances upon the chemical action of the solar spectrum. Influence of solutions and gases and vapours upon the character and position of Frauenhofer's lines and upon the refrangibility of light—researches of Bunsen and Kirchhoff and of Mr. Stokes. The refractive and dispersive powers of bodies in relation to chemical composition.

ELECTRO-CHEMISTRY.

Chemical sources of electricity. Chemical action of voltaic electricity. Chemical action of electrical discharges. Allotropism produced by electrical discharges—ozone. Laws of electro-chemical decomposition; the chemical powers of a current the same at all points of the circuit; law of electrolytic decomposition for binary compounds, neutral salts of protoxide bases, acid and basic salts, salts of sesqui oxides, &c.; the law depends upon the electro-negative element; law of the definite action of the current upon electrolytes, and its application to cases where the current traverses a mixture of electrolytes; physical conductibility of liquids; restriction of Faraday's law of the electrical equivalents; theories of electro-chemical decomposition. Electro-chemical classification.

On the voltaic couple and the various forms of the voltaic battery.

MOLECULAR ACTIONS.

Relative compressibility of different liquids. Effect of pressure upon the point of solidification of fused bodies. Capillary phenomena; the diminution of the capillary height of fluids as the temperature increases may serve as a measure of cohesion; influence of chemical composition on the capillary height. Mixture of different liquids; diffusion of liquids; phenomena exhibited at the surface of contact of liquids which do not mix; the wetting of solids by liquids; solution; capillary affinity; osmotic currents; dialysis. Influence of chemical composition upon the flow of liquids through capillary tubes, and elastic and rigid pipes. Molecular structure of bodies; tempering and annealing. Changes effected by repeated fusions. Effect of heat and pressure in modifying the molecular structure and chemical properties of bodies; properties of precipitates produced in solutions of different degrees of concentration and at different temperatures. Effect of vibration, the passage of electrical currents, unequal pressure, &c., upon molecular structure.

General considerations upon the nature of chemical affinity. Influence of cohesion upon chemical affinity; relation between cohesion and affinity. The change of volume accom-

panying chemical combination and the thermic effects resulting compared with the compressibility of bodies and the decrease of capillary height in liquids on being heated, may afford us an approximate measure of the comparative forces which act in cohesion and chemical combination. The atomic theory. Atomic volume. Isomerism. Relation between isomerism and isomorphism. Allotropism.

CHEMISTRY IN RELATION TO PHYSIOLOGY.

Relation between the form and chemical composition of plants. Comparative chemical composition of different natural families of plants.

Chemical changes which take place during the growth of plants. Decay.

Comparative chemical composition of the different tissues and fluids of animals.

Chemical changes which take place during the life of animals. Chemical phenomena of death.

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GOVERNMENT SCHOOL OF SCIENCE

APPLIED TO

MINING AND THE ARTS.

SYLLABUS OF THE LECTURES

ON

BOTANY,

TO BE DELIVERED BY

GEO. BUTLER BRADSHAW, F.R.G.S.I.;

ACTING TEMPORARILY FOR DR. HARVEY, F.R.S.

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SYLLABUS.

I. STRUCTURAL AND PHYSIOLOGICAL BOTANY.

Introduction.—Subject defined, and divided for the purposes of study. Difficulty of accurately defining a plant. Close approximation of the Vegetable and Animal Kingdoms, in some of their lowest forms. Examples of these, with explanation of Vegetable Irritability, as seen in various motions and locomotion of plants. Chief distinctive characters of animals and vegetables; anatomical, physiological, chemical, alimentary, etc.

Elementary Organs of Plants.—Cellular and Vascular Tissues. Varieties, structure, functions, and contents of each kind of Tissue. Their comparative value in the economy of Vegetation. Examples of the economic value of both cellular and vascular tissues to man. Great divisions of the Vegetable Kingdom chiefly characterized by each, respectively. Examples, from each great division, of wholly cellular, or partly cellular and partly vascular plants, to illustrate simple and compound vegetable organisms.

Complexity or Differentiation of Organs.—Meaning of these terms illustrated by comparison of simple Thallophytal, with more complex Cormophytal Cryptogams; and of the latter of these, with Phanerogamous Cormophytes, of still greater complexity. Paucity of compound organs, even in the highest plants, apparently opposed to complexity. Great diversity of form in organs having analogous functions.

Classification of Organs in Phænogamous Plants.—Nutritive or Conservative, and Reproductive, Multiplying, or Exhaustive Organs. Functions of each class, and their antagonistic influence on the health and life of the individual plant. The effects of their action in the propagation and continuation of the *species*.

The Axis of the Plant.—Ascending and Descending Axes, with their point of junction and separation. Law of Growth impressed on the germinating Seed with respect to this point. Relation between the upward and downward growth of plants, or their altitude and depth; and between the lateral extension of the branches of the Root and Stem. Importance and numerous advantages (in reference to this subject,) of the artificial loosening of the soil, and of its proper cultivation. Natural agencies employed for its comminution.

NUTRITIVE ORGANS, ETC.

Epidermal or Tegumentary System of Plants.—Nature and structure of the general protective envelope of the vegetable organs. Cuticle, epidermis, epithelium and epiblema. Tegumentary openings and appendages:—Stomata, hairs (lymphatic and glandular,) glands, stings, setæ, aculei or prickles, scurf, ramenta, warts, and lenticels. Principal functions, Nutritive, etc., etc., of the general integument and its appendages.

THE ROOT, OR DESCENDING AXIS.

Structure, functions, and absorbing parts of the Root, and its mode of imbibition. Determination by its absorbing parts, of the proper season for Transplantation. Relation of the lateral extension of Roots, and their points of absorption, to the proper mode of manuring fruit-trees, etc. Distinctions between Roots and subterranean *root-like* Stems.

Classification of Roots.—Classes founded on Mode of Development, Duration, Position and Source of Nourishment, and Configuration.

1. *Mode of Development.*—Exorhizal, Endorhizal, and Heterorhizal Modes. Correspondence of these with Primary, True, or Axial roots; or with Secondary, Abnormal, or Adventitious roots. Great divisions of the Vegetable Kingdom which they respectively characterize.

2. *Duration.*—Annual, Biennial, and Perennial roots: the first and second characteristic of plants, different, in several respects, from those to which the third belong. Principal causes of the unequal duration of annuals, biennials, and perennials. Conditions that tend to prolong the existence

of the two former, and abbreviate that of the latter. Artificial means for altering their natural period of duration.

3. *Position and Source of Nourishment.*—Subterranean, Aerial, Parasitical, Semi-parasitical, and Aquatic roots. Examples and explanations of each kind.

4. *Configuration.*—

(*a.*) Roots with a thickened, tapering, central axis, giving off *large* ramifying branches.

(*b.*) Similar roots sending out a few *small* fibres, but destitute of large subdivisions.

(*c.*) Roots in which the central axis is short, and comparatively inappreciable, and abruptly separates into fibres of varying number and thickness in different plants, but of nearly equal diameter in any individual plant.

(*d.*) Roots resembling in structure the last-named kind, but in which some (or all) of the main fibres assume a nodulose, tubercular, or other turgid appearance. Nature, cause, and functions of the swollen parts; and their economic value to man.

THE STEM, OR ASCENDING AXIS.

Caulescent and Acaulescent flowering plants. The latter term not strictly correct. Remarkable examples of acaulescent Phanerogamia. The stem (and the whole plant) composed of numerous phytons, each of which contributes to the general sustentation and growth of the entire organism; while, at the same time, maintaining a sort of independent existence. Capability of complete independence of each phyton, when detached from the plant, and placed in suitable circumstances. Practical proofs and importance of this, as seen in various horticultural operations.

Nodes and Internodes.—Nature and position of the former. Non-development and lengthening of the latter. Comparison of the dissimilar modes of elongation of the Stem and Root. Great importance of the dissimilarity. Exposition it furnishes of the long-misunderstood tendency of the Root, to extend itself in the direction of new supplies of food, when the aliment within its reach has been appropriated.

Classification of Stems.—Classes founded on their Position, Habit of Growth, Simple or Compound Character, Texture, External Form, Altitude, and Internal Structure with their Mode of Formation.

1.—Position.

(*a.*) *Aerial*:—Trunk, Stipe, Caudex, Caulis, Culm, Scape, Shoot, and Pseudo-Bulb.

(*b.*) *Subterranean*:—Bulb, (compared with Bulblet,) Corm, Crown of Root, Rhizome, Tuber, and Turio.

(*c.*) *Rameal or Branch-like*:—Sucker, Stolon, Runner, Offset, and *Cauline* Tendril. Important horticultural operations based upon correct knowledge of their nature and mode of growth.

2. Habit of Growth.—Erect, Ascending, Decumbent, Procumbent, Creeping, Climbing, and Twining Stems.

3. Simple or Compound Character.

(*a.*) *Simple, Main, or Undivided Stem*; its mode of formation, and why unbranched.

(*b.*) *Compound or Branched Stem.* Branches and their Subdivisions. Direction of Branches. Excurrent and Deliquescent Stems. Definite, Indefinite, Adventitious and Accessory branches. Transformed, fasciculate, arrested and decayed branches. Aculei or prickles of the Rose and Blackberry, compared with true rameal spines of Cratægus, Prunus, Gleditschia, etc.; and with the Spines (various in their origin) of Berberis, Ilex, Astragalus, Robinia, and Ribes.

4. Texture.—Woody, Semi-ligneous, herbaceous, fleshy or succulent, and fistular stems.

5. External Form.—Round cylindrical or terete, semiterete, compressed, ancipitate, triangular, trigonous, triquetrous, quadrangular, multangular, jointed, alate, foliaceous, aphyllous, and scaly stems. Dichotomous, and trichotomous stems, etc.

6. Altitude.—Terms applied to trees, shrubs, undershrubs and bushes, to express their differences in height, and other distinctive characters. Examples of remarkably high trees, and of climbing stems of extraordinary length.

7. Internal Structure and Mode of Growth.—Exogenous, Endogenous, and Acrogenous Stems. Meaning, and general distinguishing characters of each. Their correspondence, respectively, with Dicotyledonous, Monocotyledonous, and Acotyledonous plants.

A. Exogenous Stem.—Gradual development in a plant of one year's growth, showing its vascular and cellular systems. The same in a plant of several years' growth, showing the

arrangement of the cellular and vascular tissues, and the annual increase in diameter of trees, in temperate and cold climates. Determination of age from this mode of growth, generally easy, but sometimes difficult from several causes.

(*a.*) *Medulla or Pith:*—its position, structure, color, contents, functions, changes and obliterations. Plants in which it has been found of great economic value.

(*b.*) *Medullary Sheath:* its position, origin, structure and functions.

(*c.*) *Concentric Wood Circles.* Duramen and Alburnum; their meaning, relative position, relative proportion, structure, functions, and the gradual conversion of the latter into the former. Great economic value of many kinds of Wood.

(*d.*) *The Cambium Layer.* Nature, position, and function of the Cambium. Theories respecting the production of cambium. "Horizontal" and "vertical" theories of the annual formation of wood.

(*e.*) *The Cortical Layers or Bark.*—Cellular and Vascular systems. Repositories of various secretions. Endogenous order of the formation of the cortical layers.

Endophlœum, Liber, or Inner Bark. Its structure and special functions, especially in relation to the descent of the elaborated sap. Vast importance of its fibres in many plants, for textile fabrics and other purposes.

Mesophlœum, or Middle Bark. Form, color, and contents of its cells. Laticiferous Vessels of this, the Cellular or Herbaceous Envelope. Use of the Mesophlœum in a protective sense.

Epiphlœum, Suberous or Cork Layer. Shape and arrangement of its cells. Plants on which it is largely developed. Natural exfoliation of Cork. Its economic value, and artificial removal from the tree.

Epidermis, or thin External Bark. Its structure, and its great importance to young and herbaceous plants. Early destruction and non-renewal of the Epidermis.

Origin of each of the Cortical layers, and mode of renewal of the first three. Their limited distensibility. Provision for the increase, to an indefinite extent, of the diameter of the Stem.

(*f.*) *Medullary Rays, or Silver Grain.* Their structure, origin, direction, and use. Their *general* mode of extension towards the periphery. Secondary rays. Plants in which they are, and others in which they are not, well marked for observation.

The Ascending and Descending Sap.—Explanation furnished of the life and vigour of hollow trees, by the ascent of the crude, and the descent of the elaborated sap, through certain vessels of the Exogenous stem.

B. **Endogenous Stem.**—Meaning of the term, and error of applying it in the strict and literal sense in which it used to be understood. Development up to maturity, of a young Endogenous plant, showing its mode of growth as to the formation and arrangement of the vascular bundles, etc., compared with those of an Exogenous stem. Provision for growth in a vertical direction, but absence of all conditions for increase of diameter beyond certain narrow limits. Duration of life much shorter, therefore, than in Exogenous plants. Cause of the cylindrical and generally unbranched stems of Palms, etc. Examples of branched Endogenous stems. Difficulty of telling the age of an Endogenous tree. Approximative method of guessing the age. Reason of the great hardness of some Endogens at the periphery, where Exogens are softest.

C. **Acrogenous Stem of Acotyledons.**—Meaning of the term. Points of resemblance between this kind of stem and that of an Endogen. Distinguishing features. Nature and cause of the Cicatrices that mark Acrogenous stems.

THE LEAF AND ITS APPENDAGES.

Importance of the study of leaves. Origin of leaves. Buds: their nature, structure, functions and varieties. Difference of buds formed under dissimilar climatal conditions. Formation, growth, and expansion into the foliar axis and leaves. Terminal, Axillary, Accessory and Adventitious buds. Dependence of the normal symmetry of plants, on the perfect development of some of these, and the non-formation of others. Pollarding and Pruning trees. Latent or dormant buds; their occasional development; its cause, and importance under particular circumstances. Principles on which plants are propagated by Budding, Grafting, Cuttings, etc. Proliferous leaves.

Vernation or Præfoliation of Leaves.—Phyllotaxis, or the arrangement of leaves on the stem and its branches. Alternate, opposite, decussate and verticillate leaves. Laws of arrangement. Succession of leaves:—Cotyledonary, Primary, and Ordinary leaves. Position of leaves:—Radical, Cauline, Rameal and Floral leaves. Modes of attachment:—

Petiolate, sessile, decurrent, amplexicaul, perfoliate, connate, and sheathing leaves.

DIFFERENT PARTS OF A LEAF :—Their successional development. Modifications of some of these parts :—Ascidia, Phyllodia (these compared with Phyllocladia), Fly-traps, Ampullæ, Succulent or fleshy, and Scale-like leaves.

FOLIAR APPENDAGES :—Stipules, Ligules, and foliar Tendrils and Spines.

VENATION OF LEAVES—Reticulated, Parallel, and Radiate. Importance of Venation in Systematic Botany. Simple and Compound leaves. Diversified forms of each kind, as seen in marginal characters, and general configuration.

ANATOMICAL STRUCTURE OF LEAVES. Their Vascular and Cellular systems. Relation of the development of these to the size and shape of the foliar organs. Leaves in which either is absent, or very slightly developed. Epidermal openings and appendages of leaves. Stomata, hairs, glands, etc. Upper and lower surfaces of leaves. Vertical leaves of Australian plants.

Adaptation of leaves to climate. Foliar Physiology, and its various modes of action in the nutrition of plants. Its vast and indispensable importance to the animal kingdom, in reference to aliment, and in its influence on the atmosphere. Duration, decay, and death of leaves.

REPRODUCTIVE, OR EXHAUSTIVE ORGANS.

INFLORESCENCE OR ANTHOTAXIS.

The Floral axis and its subdivisions. Ordinary and peculiar forms of these. Bracts or Floral Leaves: their great variety of form and arrangement. Inflorescence and Flower sometimes synonymous. Points of agreement and difference between foliar and floral buds. Definite, Indefinite, and Mixed forms of Inflorescence.

THE FLOWER.

A modification of the foliar organs arranged in verticels or whorls on the Thalamus, or upper extremity of the floral axis. Pedunculate, pedicillate and sessile flowers. Bracteate and Ebracteate flowers; and ebracteate families. The Floral Envelopes and Essential Organs. Normal alternation of these. Nectaries, correctly and incorrectly so called. Dichlamydeous, Monochlamydeous, and Achlamydeous flowers. Complete, and Perfect or Monoclinate flowers. Diclinate

flowers,—Staminate and Pistillate. Neuter Flowers. Monœcious and Diœcious plants. Regular and Symmetrical Flowers. Causes and examples of Incompleteness, imperfection, irregularity, and want of floral symmetry. Aestivation or Præfloration. Floral Metamorphosis.

The Floral Envelopes.

Functions of the Floral Envelopes. Each can act for the others; and Bracts, Calyx, and Corolla often do so. The floral envelope in Monochlamydeous flowers—the whorl it represents, and how to determine it, whatever may be its colour, form, or texture.

Calycine Whorl, or Calyx.

Component parts of the calyx. Homology of sepals. Polysepalous or Dialysepalous, and Gamosepalous calyces. Different parts of the latter. Regular, Irregular, and Anomalous forms of each kind. Free or Inferior, Adherent or Superior, and half-superior calyces. Herbaceous, Glumaceous, Petaloid, and Pappose calyces. Caducous, Deciduous, Persistent, Marcescent, Accrescent, and Incorporated calyces.

Corolline Whorl, or Corolla.

Position, and component parts, of the corolla. Structure and homology of petals. Polypetalous or Dialypetalous, and Gamopetalous corollas. Different parts of the latter. Regular, irregular, and anomalous forms of each kind. Perianth or Perigone — these terms not always synonymous. Corona and other appendages of Petals. Theories of their formation. Superior and Inferior corollas. Simple and multiple corollas. Colours and odours of flowers.

Essential Organs.

Andrœcium, or Staminal Whorl.

Usual level, relatively to the floral envelopes. Exceptional level: the Anthophore, Gonophore, and Androphore. Simple and multiple, definite and indefinite stamens. Number of stamens relatively to the number of sepals or petals. Anteposition of stamens. Examples of, and theoretical causes assigned for, its occurrence.

Structure of the Stamen: Filament, Anther, Connective. Parts of a leaf to which these respectively correspond. Ordinary and peculiar forms of filament, anther and connective. Various modes of attachment of the anther to the other parts. Structure, contents, and dehiscence of the anther. Structure, function, and various forms of Pollen.

Great abundance of Pollen grains to secure the fertilization of the Ovule. Freedom, distinctness, adhesion and cohesion of Stamens. Epipetalous stamens. Cohesion by Filaments, by Anthers, and by both. Insertion and Relative length of Stamens. Included and Exserted stamens.

Gynœcium, or Pistilline Whorl.

Formed of one or more Carpels, or modified leaves. Typical form of Pistil; Ovary, Style, and Stigma. Usual level relatively to the stamens; exceptional level: the Gynophore and Carpophore. Gynobase. Structure and various forms of Ovary Style and Stigma. Comparative constancy and importance of these several parts. Their entire absence in certain families of plants.

The Ovary.—Simple, Multiple, and Compound Ovaries. Ovarian cells and their contents. True and false dissepiments in ovaries. Placentation: Axile, Parietal, and Free-central forms. Theories to account for the last-named of these. Superior and Inferior Ovaries.

The Ovule, or Rudimentary Seed.—Nature, development, and ultimate structure of the Ovule. Its various positions in, or directions with respect to certain parts of, the Ovary. Relative positions of its nucleus to the hilum and foramen: Orthotropal, Campylotropal, Anatropal, Semi-anatropal and Amphitropal Ovules.

Fertilization of the Ovule.—Different theories of fertilization. Various natural modes of securing it. Artificial methods: Phoenix dactylifera, Ficus carica, etc. Hybridization: its general laws, and horticultural importance. Crossing. Production and fertilization of Spores in Cryptogamic plants. Antheridia and Archegonia. Ferns, Mosses, Seaweeds, etc. Reproduction of Diatomaceæ and Confervæ.

THE FRUIT, OR MATURED OVARY.

The Pericarp: Epicarp, Mesocarp, (Sarcocarp), Endocarp. (Putamen.) Dehiscent and Indehiscent Fruits. Various modes of Dehiscence.

Classification of Fruits.—Apocarpous, (simple and multiple,) Syncarpous, and Aggregate or Confluent Fruits. Diversified forms of each Group. Fruits specially important as staple articles of human food, and as sources of valuable products extensively used in domestic economy, the arts and manufactures.

The Seed, or Matured Ovule.—Difference between the

Ovule and the Seed. Number, abortion, and suppression of seeds. Spermal integuments and appendages. Albuminous and Exalbuminous seeds. Importance of each kind in Systematic Botany. Chemical composition, function, and various kinds of albumen in seeds. Relative size of the albumen and embryo, and their relative positions in internal and external embryos.

THE EMBRYO OR RUDIMENTARY PLANT: its Radicle, Plumule, and Cotyledons. Functions of each part, and the development of the cotyledons in relation to that of the albumen. Monocotyledonous, Dicotyledonous, and Polycotyledonous embryos. Diversity of opinions on the last-named kind. Acotyledonous spores of flowerless plants. Suppression and diminution of cotyledons in flowering plants: Cuscuta, Orchis, etc. Epigeal and hypogeal cotyledons. Seeds extensively used as food, and for various other important purposes.

Function, Vitality, and Germination of Seeds. Time occupied in germination of different seeds. Chemical and mechanical changes that take place in Germination. Physical conditions that favour it. Great importance of a correct knowledge of these, and its practical application in the improvement and proper cultivation of the soil. Dissemination of seeds, and Nature's numerous and greatly diversified modes of securing it. General Laws affecting the Geographical Distribution of Plants.

II. SYSTEMATIC BOTANY.

CLASSIFICATION OF PLANTS.—Objects and importance of Classification. Species, Varieties, and Races. Genera, Orders, Classes, etc. Artificial and Natural systems of classification: their respective merits and defects. General outlines of the Linnæan, or principal artificial system. Outlines of the Natural system adopted in the Lectures.

DESCRIPTION OF NATURAL FAMILIES OR ORDERS, selected from each of the great divisions of Phænogamous or flowering plants, as follows:—

1. *Angiospermous Dicotyledons:* Thalamifloral, Calycifloral, Corollifloral, and Incomplete (or Monochlamydeous and Achlamydeous) Orders.
2. *Gymnospermous Di-Polycotyledons:* Coniferous and Cycadaceous Orders.
3. *Monocotyledons:* Dictyogenous, Petaloideal and Glumaceous Orders.

III. ECONOMIC BOTANY.

The Vegetable Kingdom a great source of food, clothing, medicine, etc., from the earliest times. Proportion borne by vegetable products, to the entire raw produce employed in the commerce of the United Kingdom. Other statistical data for estimating the value of such productions, as sources of the national Revenue. Palæophytology in relation to Economic Botany. Important value of the now fossilized Floras of certain Geological Formations.

Ultimate Elements and Proximate Principles of Plants. Botanical and Statistical description of various plants and vegetable products used for Alimentary, Textile, Medicinal, and other important purposes, in domestic economy, the arts, and manufactures.

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SYLLABUS OF THE LECTURES

ON

ZOOLOGY,

TO BE DELIVERED BY

MR. MORGAN, F.R.C.S.I.

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SYLLABUS.

ZOOLOGY.

Professor, John Morgan, F.R.C.S.I., acting Pro. Tem.

I. Physiological.

Introduction.

Organized being: definition of term. Necessary conditions of Organized Existence. Functions of Organized Life. Necessary connexion between Function and Organs. Simple Organs. Compound Organs. Complex Organs. Simple, Complex, and Compound Functions. *Organs in different Animals may be either identical in Structure and Position, or else only similar in appearance. Organs identical in structural relations may perform different Functions in different Animals.* Homology, or *structural* identity. Analogy, or *functional* similarity. Limits of these. Importance of a correct and definite idea of their meaning.

The two phases of Organized Existence. The Plant, or Phyton. The Animal, or Zoon. Their relations, agreements, and contrasts. Their distinctness in mode of growth, origin, composition, and development. *Many of the Forms and Functions of the Plant found to exist in the Animal, along with certain Functions and Forms peculiar to Animals.*

Functions of Animal Life twofold, viz., *either those held in common with Plants, or those peculiar to Animals: the former called, therefore, Vegetative; the latter, Animal.*

Vegetative Functions in Animal Existences considered in their most complete development:—

I. Nutrition and its Organs. Objects and Essentials. Its relation to other Functions and the varieties of food. Objects of Function fourfold. Its operations divisible into—Prehension and Mastication; Organs thereunto subservient and their modifications. Digestion—the Organs accessory thereto. Assimilation and Growth—Absorption means, laws, and varieties of.

Circulation—the Organs concerned therein; its causes and

varieties. The Types and Adaptation of Circulatory Organs suited to the various circumstances of life. General outline and structure in Animal Kingdom.

Respiration — Atmospheric and Aquatic: Its Types. Organs engaged and their adaptation—Tracheæ; Cutaneous Respiration; Sacs; Lungs. Aquiferous Vessels; Skin (stomates); Gills or Branchiæ. Circulation and Absorption: Organs. Excretion. Secretion.

II. Increase. *Increase by similar Cells.* The simple Cell; its modes of increase. Gemmation. Fission. Free Cell-Growth.

III. Reproduction. Increase by dissimilar Cells. Conjugation. Viviparous, Oviparous, Ovo-viviparous Animals. Parthenogenesis, Metagenesis, Agamogenesis. Many of these peculiar to the Animal.

Development.—Changes undergone during growth of Animal. Metamorphosis, complete, incomplete. Ammocœte Tadpole, Larva, Zoe, Cercaria. Alternation of Generations.

Animal Functions.

IV. Motion—contractility, elasticity. Difference between Animal and Vegetable Motions. The latter met with in Animals. The Animal Skeleton or supporting system of Organs. Protective and progressive Exoskeleton tegumentary and cutaneous systems; systems of appendages, &c. Endoskeleton. Mesoskeleton. Muscular or true Motive System. Sinews. Tendons, levers, and joints.

Nervous System; its general structure and office; its connexion with Animal life and increasing importance and relation to perfection of being; its office as Reflex, Consensual, and Mental Relation to vegetative or Organic Functions.

V. Sensation and Direction. Sensatory Centres, or Nervous Ganglia. Sensatory directive Filaments, or Nerves.

Special arrangements of each of these in the great Primary Groups, the characters drawn from Functions of Sensation being the best marked.

The Senses.

Sensation—Its relation to structure of nervous centres.

Touch—The Organs of their modifications and relation to mode of life.

Taste—Its relation to Touch and other senses, and to food.

Smell—Organs engaged in Animal scale—Modifications—Scent—Aquatic and Aerial, &c.

Hearing—Modifications of Organs and general structure. Varieties of Position, &c. Intercommunication of Voice.

Sight—Relation to Sensation. Various adaption of Position and Structure. Simple, Compound, &c.

Existence of Types. Explanation of term Type. The great primary Animal Types or Holotypes: Vertebrata, Mollusca, Articulata, Radiata, Acrita. All Animals known referrible to one or other of these. Distinctness and stability of these Types. Examples of them. Secondary or sub-Types: Class, Order, sub-Order, Family, Genus, sub-Genus, Species. *Groups founded on a series of characters drawn from the Arrangement of Organs.* Apparent interchange or rather gradations of characters in these Groups. Limited variation of Typical characters in each Group, &c. Consideration of these. Explanation of terms *higher* and *lower*, as applied to Groups. *Those Groups in which greatest differentiation takes place called highest; therefore, highest Animals have most complex Functions, and vice versâ.*

II. Classification.

Intentions, necessity, and objects of Classification. Systems of Classification. *The Artificial, or that dependent on accidental agreement of characters arbitrarily chosen.* Systems of Aristotle, Linnæus, Ray. Early Systems of Hunter. *Natural System, or that dependent on presence or absence of characters having a natural connexion and dependence on each other.* Systems of Hunter, Cuvier, Owen, and the moderns

General definitions of Holotypes, Vertebrata, Mollusca, Articulata, Radiata, Acrita.

Differentiation of Organs in these. Nervous System undetected in Acrita.

The following System of analogous Organs present in most Animals:—A Tegumentary or Protective. A Skeleton or Supporting. A Muscular or Motive. A Nutritive, or Assimilative and Circulatory. A Reproductive. A Sensatory and Directive. All more or less highly developed, and all arranged on different plans in each Type.

Relations between the several systems of organs constant in the same Type, so that the general arrangement known in one, we can reconstruct the general plan of the entire. *Harmony of organs.* Value of this law in Palæontology.

Modification of Types due to accidental disturbing causes. Races or Animals of cultivation. Man and his races. Domesticated races. Alteration of Type not a necessary consequence of cultivation. Variety or change due to accidental natural causes generally limited to restricted districts. Tendency to revert to original Type.

VERTEBRATA.

[Names in *italics* those of extinct Groups].

Nervous centres enclosed in brain case and back bone; bilateral symmetry.

I. MAMMALIA,
Viviparous. Warm blooded; heart quadrilocular:
1. Archencephala.
Cerebral lobes concealing cerebellum and olfactory lobes. Corpus callosum.
Bimana. Thumb on anterior limbs only. (Man.)
2. Gyrencephala.
Lobes of cerebrum convoluted, cerebellum uncovered, olfactory lobes concealed. Corpus callosum.

A [*Digits with a nail.*]
a Quadrumana. Thumb on hind and fore limbs.
1. Catarrhina. (Gorilla, Chimpanzee, Macacus, *Pliopithecus.*)
2. Platyrrhina. (Cebus, *Protopithecus.*)
3. Strepsirrhina. (Aye Aye, Lemur)

b Carnivora.
1. Digitigrada. (Dog, Cat, Lion, Wolf, Fox, *Machairodus*, *Palæcyon.*)
2. Plantigrada. (Badger, Bear, *Hyænodon.*)
3. Pinnigrada. (Seal, Walrus.)

B [*Digits with a hoof.*]
c Artiodactyla. Even-toed on hind limbs.
1. Omnivora. Stomach simple. (Hippopotamus, Pig, Dicotyles, *Anoplotherium*, *Hyracotherium.*)
2. Ruminantia. Stomach compound. (Camel, Llama, Giraffe, *Irish Elk*, Deer, Cow, *Sivatherium.*)

d Perissodactyla. Odd toes on hind limbs.
1. Solidungula. Hoof single. (Horse, *Hipparion.*)
Multungula. Toes three or more. (Rhinoceros, Tapir, *Palæotherium.*)

e Proboscidia. Proboscis bearing mammals.

[1]. *Dinotherium.* Inferior incisors long, bent downwards. (*D. giganteum.*)

[2]. *Mastodon.* molars mammillated. Dentition, $\frac{1}{1}$ or $\frac{1}{0}$ or $\frac{0}{0} \cdot \frac{0}{0} \cdot \frac{2,\ 3}{2\ \ 3}$ or $\frac{0,\ 3}{0\ \ 3}$.

Pentalophodon. intermediate molars, five ridged. (*P. Sivalensis.*)

Tetralophodon. intermed. mol., four ridged. (*Tetr. Arvernensis.*)

Trilophodon. intermed. mol., three ridged. (*Tr. Ohioticus.*)

[3]. Elephas. molars ridged or plaited. Dentition, $\frac{1}{0} \cdot \frac{0}{0} \cdot \frac{2,\ 3}{2\ \ 3}$ or $\frac{0,\ 3}{0\ \ 3}$.

Stegodon. molars ridged, roof-shaped. Præmolars [?]. (*Steg. insignis.*)

Loxodon. molar lamellæ wedge-shaped. Præmolars, $\frac{2}{2}$ or $\frac{0}{0}$. (African Elephant, *L. planifrons.*)

Euelephas. molar lamellæ compressed. Præmolars, $\frac{0}{0}$. (Indian Elephant, *Mammoth.*)

f *Toxodontia.* (*Nesodon, Toxodon.*)

C [*Pectoral limbs as fins, posterior limbs wanting.*]

g Sirenia. Herbivorous Whales. (Manatee, *Stellerine, Zeuglodon,* Dugong.)

h Cetacea. True Whales. (Whale, Rorqual, Dolphin, Porpoise, *Cetotherium.*)

3. Lissencephala. Olfactory lobes and cerebellum uncovered, cerebrum smooth.

a Bruta. (Anteater, Armadillo, Sloth, *Megatherium, Glyptodon, Mylodon.*)

b Cheiroptera. Winged-handed Mammals.
[1]. Frugivoridæ. (Pteropus.)
[2]. Insectivoridæ. (Flittermouse, or Bat.)
c Insectivora. (Shrewmouse, Hedgehog, *Galerix*, *Galeospalax*, Mole.)
d Rodentia. (Gnawers.)
[1]. Nonclaviculata. (Hare, Porcupine, *Cricetodon*.)
[2]. Claviculata. (Squirrel, Rat, Vole, Beaver, *Plesiarctomys*.)

4. Lyencephala.

Corpus callosum wanting, aplacental reproduction.
a Marsupialia. (Pouched Mammals.)
[1]. Rhizophaga. (Wombat.)
[2]. Poephaga. (Kangaroo, Kangaroo Rat, *Diprotodon*.)
[3]. Carpophaga. (Koala, Australian Opossum, Sugar Squirrel.)
[4]. Entomophaga. (Australian Cat, Virginian Opossum.)
[5]. ————. (*Thylacotherium*, *Phascolotherium*.)
[6]. Sarcophaga. (Tasmanian Wolf, Ursine Opossum, *Microlestes* [?] *Thylacoleo*).
b Monotremata.
Echidna, Platypus.

II. Aves or Birds,

Oviparous. Warm blooded; heart quadrilocular:
1. Raptores. (Hawk, Eagle, Vulture, *Lithornis*, Owl.)
2. Incessores.
a dentirostres. (Thrush, Wheatear.)
b conirostres. (Crow, Sparrow, Bunting.)
c scansores. (Woodpecker, Parrot, Wren, *Halcyornis* [?], Cuckoo.)
d tenuirostres. (Honeyeater, Humming-bird, Hoopoe, Bird of Paradise.)
e fissirostres. (Bee-eater, Roller, King fisher, Goat-sucker, Swallow.)
3. Rasores. (Pigeon, *Dodo* [?], Grouse, Partridge.)
4. Cursores. (Ostrich, Emeu, Apteryx, *Dinornis*, *Æpyornis* [?], *Palapteryx*.)

5. Grallatores.
   a Pressirostres. (Bustard.)
   b Cultirostres. (Flamingo, Heron, Crane.)
   c Longirostres. (Curlew, Snipe.)
   d Macrodactyli. (Rail, Waterhen, Coot, Notornis.)
6. Natatores.
   a Lamellirostres. (Swan, Duck, Merganser.)
   b Totipalmides. (Pelican, Cormorant.)
   c Mersatores. (Diver, Auk, Penguin.)
   d Longipennidæ. (Gull, Seaswallow, Petrel.)

III. HÆMATOCRYMES.

A. III. Reptilia.

Oviparous or ovo-viviparous, cold blood, skin covered with scales or plates, breathe by lungs; heart trilocular. Scales epidermic, horny.

1. *Dinosauria.* (*Megalosaurus, Iguanodon, Hylæosaurus.*)
2. *Pterosauria.* (*Pterodactyle.*)
3. Testudinata. (Tortoise, Turtle.)
4. *Anomodontia.*
   a Dicynodontia. (*Dicynodon.*)
   b Cryptodontia. (*Oudenodon.*)
5. Loricata.
   a Procœli. (Crocodile, Alligator, Gavial.)
   b Amphicœli. (*Teleosaurus.*)
   c Prosthocœli. (*Steneosaurus, Cetiosaurus.*
6. *Thecodontia.* (*Thecodontosaurus, Palæosaurus.*)
7. Squamata.
   a Sauria. (Lizard, Iguana.)
   b Saurophidia. (Slowworm, Scinck.)
   c Ophidia. (Serpent, Snake, *Palæophis.*)
8. *Enaliosauria.*
   a Ichthyopterygia. (*Ichthyosaurus.*)
   b Sauropterygia. (*Plesiosaurus, Pliosaurus, Simosaurus.*)

B. III. Batrachia or Amphibia.

Oviparous, cold blood, generally naked skin, undergo metamorphosis for the most part, breathe by lungs or branchiæ, or both; heart trilocular.

1. Abranchia. no metamorphosis (?) or branchiæ limbs four. (Menopoma, Amphiuma.)
2. Urodela. tail persistent. metamorphosis limbs four. (Newt, Salamander, *Andrias.*)

3. Anoura. tail deciduous. metamorphosis. limbs four. (Frog, Toad, *Palæobatrachus.*)
4. Apoda. body anguiform. metamorphosis. limbs none. (Cecilia.)
5. Amphipneusta. gills persistent. metamorphosis. limbs four or two. (Proteus, Siren, Menobranchus.)
6. Lepidota. body scaly, fish-shaped. limbs four, rod-like. (Lepidosiren, Protopterus.)
7. *Ganocephala.* head with ganoid bony plates. limbs, four natatory. (*Archægosaurus.*)
8. *Labyrinthodontia.* (*Labyrinthodon.*)

c. III. Pisces or Fish.

Cold blood, oviparous, breathe by branchiæ; heart bilocular. Scales developed as distinct organs in substance of skin.

1. Plagiostomi. scales placoid. skeleton cartilaginous or osteoid. gills fixed. gill openings five or more.
   - *a* Squali. (Shark, Cestracion, *Ctenodus.*)
   - *b* Raiæ. (Torpedo, Sawfish, *Cyclarthrus.*)
2. Holocephali. scales placoid. skeleton cartilaginous. gills fixed by margin. gill opening one. (Chimæra, *Elasmodus.*)
3. Ganoidea. scales ganoid. skeleton osseous, cartilaginous or osteoid. (Lepidosteus, Polypterus, Sturgeon, *Chondrosteus, Coccosteus, Cephalaspis.*)
4. Lophobranchii. scales ganoid. skeleton osteoid. gills tufted. (Pipe-fish, Sea-horse, *Calamostoma.*)
5. Plectognathi. scales ganoid. skeleton osteoid. maxillary and premaxillary bones soldered. (File-fish, Globe-fish, Sun-fish, *Acanthoderma, Blochius.*)
6. Acanthopteri. scales ctenoid, rarely cycloid. skeleton osteoid or osseous. (Thynnus.) anterior rays of fins inflexible. (Perch, *Holopteryx*, Gurnard, Mackerel, *Callipteryx.*)
7. Anacanthini. scales ctenoid or cycloid. skeleton osteoid. fin rays flexible.
   - *a* Thoracici. (Ophidium, Cod.)
   - *b* Anisomeri. (Plaice.)
   - *c* Colacides. (Remora.)
8. Pharyngognathi. scales ctenoid or cycloid. skeleton osteoid. Inferior pharyngeal bones soldered.

a Acanthopterygii. (Saury-pike.)
b Malocopterygii. (*Platylemus*, Flying-fish, Wrasse.)

9. Malacopteri. scales cycloid or ganoid. skeleton osseous or osteoid. gills free operculate. fin rays for the most part soft.
   a Helmicthyi. (Anglesey Morris.)
   b Apodes. (Eel.)
   c Abdominales. (Herring, Salmon, Pike, *Holosteus.*)
10. Cyclostomata. gills fixed; bursiform; inoperculate. skeleton cartilaginous. (Myxine, Lamprey.)
11. Leptocardia. gills pharyngeal; free; inoperculate. Skeleton cartilaginous. heart absent. (Lancelet.)

Agassiz's Classification.

1. Ganoideans. (Lepidosteus, *Coccosteus, Pterichthys, Cephalaspis*, Sturgeon.)
2. Placoideans. (Sharks, *Spinax. Sclerodus*, Rays.)
3. Ctenoideans. (Perch, *Beryx.*)
4. Cycloideans. (Carp, *Rhonchus*, Herring, Salmon.)

Some place the Protopterus (*vide* Batrachia) among the fish as the type of a family, Protopteri. They also unite 10 and 11 under the name of Dermopteri.

MOLLUSCA, OR HETEROGANGLIATA.

Nervous centres scattered, unsymmetrical, bodies soft.

I. Cephalopoda.

Bodies symmetrical, head distinct, arms around head, respiration by branchiæ in special cavity.

1. Dibranchiata.
   branchiæ 2.
   a octopoda. (Argonaut, Poulpe.)
   b decapoda. (Squid, *Belemnite*, Spirula.)
2. Tetrabranchiata.
   branchiæ 4. (Nautilus, *Orthoceras, Bacculite, Ammonite.*)

II. Cephalophora.

Bodies unsymmetrical, head distinct. respiration various some species undergoing metamorphosis.

1. Gasteropoda.
   foot a broad fleshy disk.

a prosobranchiata. branchial respiration; special cavity. (Chiton, Whelk, Ianthina, Limpet, *Euomphalus*, Periwinkle.)

b pulmonifera. pulmonary cavity. (Snail, Slug.)

c opisthobranchiata. branchial respiration. (Doris, Aplysia, Bulla.)

2. Heteropoda.
foot a vertical plate, (*Bellerophon*, Atlantas, Carinaria, Firola.)

3. Pteropoda.
fins each side of head, (Clio borealis, Hyalea, *Pterotheca*.)

III. Acephala or Conchifera Lamellibranchiata.

Body unsymmetrical, lamellar branchiæ between folds of mantle, valves of shell lateral.

1. Asiphonophora.
Mantle lobes either free or united at back only. (Oyster, Mussel, Arca, Unio.)

2. Siphonophora.
Animals furnished with retractile siphons. (Chama, Cockle, Teredo, Cyclas, Razor-shell, Mya, Pholas, *Hippurites*.)

IV. Molluscoidea.

Bodies unsymmetrical, nervous ganglions.

1. Brachiopoda or Palliobranchiata.
Respiration by edges of mantle, arms attached to each side of mouth, shells dorsal and ventral.

a Lingulidæ.
Peduncle passing between valves. (Lingula, *Obolus*).

b Terebratulidæ.
Peduncle passing through ventral valve. (Terebratula, *Spirifer*, *Pentamerus*, *Orthis*, *Productus*.)

c Craniadæ.
(Crania, Discina.)

2. Tunicata or Ascidioida.

a Biphoridæ, mantle coriaceous.
Branchiæ band-like, circulation flux and reflux. (Biphora.)

b Ascididæ.
Branchiæ netted. (Botryllus, Clavellina, Ascidia, Pyrosoma.)

3. Polyzoa or Bryozoa.
   Ciliated tentacles around mouth. Animals in groups, reproduction oviparous or gemmiparous.
   a Lophopoda.
   Tentacles on arms each side of mouth. (Plumatella.)
   b Infundibulata.
   Tentacles in circle around mouth. (Flustra, Bowerbankia, Crisis.)

ARTICULATA, OR ANNULATA.

Nervous centres in pairs symmetrically arranged in parallel lines.

I. Insecta.

Legs six, head, thorax, and abdomen distinct, respiration tracheal, metamorphosis.

1. Coleoptera. Wings, four, two, or none, upper wings generally coriaceous, mouth with jaws. (Beetle, *Carabites,* Stylops.)
2. Neuroptera. Wings, four or none, mouth with jaws, wings with interlacing venules. (Earwig, Locust. Cricket, Dragon-fly, White Ant, Lepisma, *Dictyophlebia.*)
3. Lepidoptera. Wings four or none, scaly. Mouth, suctorial. (Butterfly, Moth.)
4. Hymenoptera. Wings four or none. Venules free. Mouth, suctorial. (Bee, Sawfly, Ichneumon, Ant, Wasp, *Cephites, Attopsis.*)
5. Diptera. Wings, two or none. Under wings as halteres. Mouth, suctorial. (Flea, Housefly, Mosquito.)
6. Hemiptera. Wings, four or none. Coriaceous at their base. Mouth, suctorial. (Bug, Cicada, Aphis, Pediculus, *Blattina.*)

II. Crustacea.

Body articulated, cephalo thorax and abdomen, articulated limbs, dermal or branchial respiration, undergo metamorphosis.

1. Podophthalmia. Eyes on footstalks, thoracic rings concealed beneath carapace.
   a Eubranchiata or decapoda.
   legs ten, branchiæ in special cavity.
   [1]. brachyura. (Crab, *Xanthopsis.*)
   [2]. anomoura. (Hermit Crab.)
   [3]. macrura. (Lobster.)

b Anomobranchiata.
branchiæ various.
1. stomapoda. Feet around mouth. (Squill.)
2. schizopoda. Feet numerous, cleft. (Mysis.)
3. aploopoda. Feet simple, numerous. (Leucifer.)

2. Choristopoda or tetradecapoda. Eyes sessile, thoracic rings exposed.
thoracic feet fourteen; branchial vesicles.

a. Amphipoda.
branchial vesicles thoracic, thoracic feet 8 anterior, 6 posterior. (Gammarus, Cyamus, *Prosoponiscus*.)

b. Anisopoda.
branchial vesicles abdominal, thoracic feet 8 anterior, 6 posterior. (Tanais, Arcturus, Serolis.)

c. Isopoda.
branchial vesicles abdominal, thoracic feet 6 anterior, 8 posterior. (Wood-louse, Ligia, *Archægoniscus*.)

3. *Trilobites*. (*Calymene*, *Paradoxides*, *Trinucleus*, *Asaphus*, *Agnostus*.)

4. Entomostraca.

a. Gnathostomata. movable jaws.
1. phyllopoda.
segments numerous, with foliaceous appendages beneath. (Apus, Limnadia, *Dithyrocaris*.)
2. lophyropoda.
feet few, posterior part of body, furnished with hairy appendages. (Cyclops, Daphnia, Cypris, *Caprella*.)

b. Cormostomata.
mouth with retractile sucker. (Caligus, Lernæa.)

c. Merostomata.
basal joints of legs, as jaws. (Limulus, *Bellinurus*.)

d [?] *Eurypteridæ*. (*Eurypterus*, *Pterygotus*.)

5. Cirripedia.
a thoracica. (Barnacles, Lepas, Verruca.)
b abdominalia. (Cryptophialus.)
c apoda. (Proteolepas.)

III. Arachnida.
Eight articulated imperfect thoracic limbs, cephalothorax, and abdomen, respiration various, metamorphosis.

1. Pulmonaria. pulmonary cavity. Abdomen only articulated.

a Scorpionidæ. cephalo thorax and abdomen indistinctly separated. cheliceres forficulate. (Scorpion, Androctonus. *Sc. cyclopthalmus*.)

b Phrynidæ. abdomen distinct. cheliceres. nailed. (Phrynus.)

2. Dipneusta. Respiration tracheal and pulmonic. Abdomen and cephalo thorax distinct, unarticulated. (Mygale, House Spider.)
3. Trachearia. Respiration tracheal. Cephalothorax unarticulated or biarticulated.
   a Solpugidæ. Abdomen articulated, distinct. palpi simple. (Galeodes.)
   b Pseudoscorpii. Abdomen articulated, semifused. palpi forficulate. (Chelifer, Obisium, *Microlatis.*)
   c Opilionidæ. Abdomen articulated, semifused. palpi simple. (Phalangium.)
   d Acarinæ. Abdomen unarticulated, fused. palpi simple. (Sarcoptes, Acarus, Trombidium.)
4. Apneusta. Cephalo thorax multiarticulate. No special respiratory organs.
   a Pycnogonidæ. Abdomen rudimentary. (Nymphon, Pycnogonum.)
   b Tardigrada. Abdomen none. Legs rudimentary. (Linguatula [?], Milnesium.)

IV. Myriapoda.

Body articulated, joints all distinct, numerous articulated limbs, undergo partial metamorphosis, respiration tracheal.

1. Chilopoda.
   (Centipede, Geophilus, Cermatra, Lithobius.)
2. Chilognatha.
   (Glomeris, Julus, Polydesmus.

RADIATA.

Nervous filaments or threads.

I. Rotatoria.

mouths surrounded by ciliated lobes.

a. Sessilia (Floscularia).
b. Natantia (Polytrochus).

II. Annellida.

Body ringed, no limbs. Metamorphosis.

1. Dorsibranchia or Errantia.
   , branchiæ attached to each segment.
   (Eunice, Nereis, Seamouse, Lugworm.)
2. Tubicolæ.
   branchiæ to anterior segment.
   (Terebella, Serpula, Sabella.)

3. Scolecidea.
pulmonic (?) cavity.
double rows of bristles along side.
(Earthworm, Nais.)
4. Suctoria.
bodies with sucking discs. Pulmonic (?) cavity.
(Leech, Branchiobdella.)

III. NEMATELMIA.

Body elongated, cylindrical.
1. Nematoidea. (Ascaris, Guineaworm.)
2. Gordiaceæ. (Gordius.)
3. Acanthocephalaceæ. (Echinorhynchus.)

IV. PLATYELMIA.

Body flattened, no segmentation. Animal often compound.
1. Planaridea.
free. Ciliæ. (Turbellaria, Borlasia (?) Planaria.)
2. Trematodea.
parasitic, body short, elliptical.
(Distoma, Tristoma, Polystoma.)
3. Cestoidea.
parasitic, generally compound, bodies flattened.
(Tapeworm. Bothriocephalus.)

V. ECHINODERMATA.

1. Sipunculoidea. (Sipunculus.)
2. Holothuriadea. (Sea cucumber, Nigger.)
3. Echinoidea.
a Spatangidæ. (*Holaster*, Spatangus, *Ananchytes*.)
b Clypeastridæ. (Pea Urchin, *Clypeus*.)
c Cidaridæ. (Egg Urchin, Piper.)
4. *Perischœchinoidea.* (*Palæchinus.*)
5. Asteroidea. (Sunstar, *Palæaster.*)
6. Ophiurioidea. (Sandstar, Brittlestar.)
7. Crinoidea.
a Comatulidæ. (Featherstar, *Pterocoma.*)
b *Cupressocrinidæ.* (*Cupressocrinus.*)
c *Polycrinidæ.* (*Eucalyptocrinus.*)
d *Haplocrinidæ.* (*Haplocrinus.*)
e *Anthocrinidæ.* (*Crotalocrinus.*)
f *Cyathocrinidæ.* (*Cyathocrinus, Actinocrinus, Platycrinus, Carpocrinus.*)
g Pycnocrinidæ. (*Eugeniocrinus, Encrinus, Apiocrinus,* Pentacrinus.)

8. *Blastoidea.* (*Pentremites, Isocrinus.*)
9. *Cystidea.* (*Caryocrinus, Cystis.*)

Some systematists place Sipunculoidea among the Annellida.

Huxley unites Articulata and Radiata as Annulata, dividing them into Articulata corresponding to Articulata, and Annulosa corresponding to Radiata.

PROTOZOA OR ACRITA.

No nervous centres or filaments as yet detected.

I. Polypifera, or Cœlenterata.

1. Actinozoa. digestive sac suspended in general cavity.
    - *a* Asteroida, tentacles eightfold. (Alcyonium, Red coral, Music coral.)
    - *b* *Rugosa* (*Cyathophyllum.*)
    - *c* Helianthoida, tentacles five or sixfold. (Sea anemones.)
    - *d* Ctenophora. (Beroe, Cestum Veneris.)
2. Hydrozoa. No general cavity.
    - *a* Lucernaroida. Polype single, with a swimming organ.
        - 1. Lucernaridæ. Natatorial organ, with adherent base. (Lucernaria.)
        - 2. Medusidæ. (Æginopsis.)
    - *b* Siphonophora. Polypes several in cœnosarc, with natatorial organs.
        - 1. Physophoridæ. Cœnosarc dilated into a float. (Portuguese man-of-war.)
        - 2. Calycophoridæ. (Diphys, Cymba.)
    - *c* Hydroida.
        - 1. Sertularidæ. Polyps with cœnosarc in cells, fixed. (Sertularia, *Oldhamia.*)
        - 2. Tubularidæ. Polyps, naked, fixed. (Tubularia.)
        - 3. Hydridæ. Polype single naked, free. (Hydra.)

II. Oozoa or Protozoa.

1. Infusoria. (Vorticella, Euglena.)
2. Porifera. (Sponges.)
3 Rhizopoda. (*Nummulites,* Foraminifera, Amæba.)

Huxley places Oozoa as a subkingdom.

IV. ECONOMIC ZOOLOGY.

I. Animal Substances used in Arts and Manufactures:

Oils and Fats, and allied substances; Mammalian Oils and Fats: the sources whence derived and modes of procuring. Fish Oils: modes of production. Wax: the Insects which furnish it.

Skin and tegumentary appendages; Skins, Furs, Hides, Shagreen, Wools, Hair: sources whence derived. Bristles, Whalebone, Horn, Tortoiseshell, Cameos: Pearly manufactures.

Skeleton and allied substances: Bone, Ivory, Sponge, Coral.

Animal Dyes mechanically prepared; Dye Insects.

Miscellaneous substances: Glue, Isinglass, Silk.

Alimentary substances.

II. Animals noxious to Man:

Insects, &c., hurtful to the Agriculturist; Insects, &c., hurtful to the Manufacturer.

III. Animals cultivated by Man; Review of domesticated races; other domesticated Animals.

IV. Animals of capture:

Animals hunted for their Skins and Furs, &c.

Fisheries: Home Fisheries, Foreign Fisheries: description and enumeration of modes of capture, and sources whence several baits employed are derived.

Class-books recommended: Dallas' "Natural History of the Animal Kingdom;" Green's "Manual of Protozoa."

Additional for Honors: Carpenter's "Principles of Comparative Physiology;" Siebold's "History of Invertebrata," translated by Burnett; Rymer Jones' "Animal Kingdom;" Owen's "Classification and Distribution of Mammalia;" Owen's "Palæontology."

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Science and Art Department.

GOVERNMENT SCHOOL OF SCIENCE

APPLIED TO

MINING AND THE ARTS.

SYLLABUS OF THE LECTURES

ON

GEOLOGY,

TO BE DELIVERED BY

PROFESSOR J. BEETE JUKES.

DUBLIN:
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1867.

SYLLABUS.

GEOLOGY.

Professor, J. Beete Jukes.

Divided into :—

A. Physical Geography.

B. Geognosy.

C. Palæontology.

D. History of the formation of the Crust of the Earth.

PHYSICAL GEOGRAPHY.

Part I.

1. Form of the Earth, its Specific Gravity and Internal Heat.

Question as to Fluidity or Solidity of Interior.

2. Unevenness of the Surface of the Earth—Hollows, or Depressions below a certain level, filled with water and called Seas and Oceans—Elevations above that level form Dry Land—Comparison of the Area, the Shape or Contour, and the "Mould" or general form of the Land and of the bed of the Ocean—Mean Height of the Land, and Mean Depth of the Sea.

3. Land may be portioned out into Mountains and Hills, Table Lands, Plains, and Valleys. Mountains occur either Singly, or in Groups, Ranges, or Chains. Valleys among Mountains become Glens or Ravines.

4. Mountain Chains are composed of one range, or of two or more nearly parallel ranges, sometimes inosculating, sometimes divergent, sometimes connected, sometimes unconnected—and of lateral spurs running nearly at right angles to Chains.

Inosculating ranges enclose isolated Table Lands, or mountain Valleys; other ranges are separated or traversed by longitudinal and lateral Valleys.

5. Valleys connected together, so as to form a system of

channels for conveying water into one central artery, producing a number of tributary streams to one main river.

Lateral Valleys are the first formed; longitudinal Valleys being of secondary origin, though often larger than lateral ones.

Each system of Valleys forms a "Basin of Drainage," or "River-basin." Basins of Drainage, separated by "water sheds," or ridges more or less abrupt, of elevated ground, from which the brooks fall each way.

Most River-basins drain into the Ocean. Some are independent, and form Inland Seas or Salt Lakes, often called Caspians. Description of most remarkable Basins of Drainage.

6. Mountain Chains may be classed as Principal and Subordinate—Two Principal Mountain Chains, *a*. Indo-European Chain of Old World, running nearly East and West, *b*. Andes and Rocky Mountains of New World, running nearly North and South—Subordinate Chains numerous. Description of most remarkable Mountain Chains. Shape of Lands governed by direction of Principal and Subordinate Chains, slope of Plains and Valleys depending on Mountain Chains as axes of elevation.

Relation of the two principal Mountain Chains and their River Basins to the two great Oceans, the Atlantic and Pacific.

7. The Atmosphere and the Sea—their Physical and Chemical Constitution, extent, weight, colour, temperatures, and movements. Distribution of Solar heat, vertically and laterally; Isothermal lines; Cold in upper regions of Atmosphere; Snow line. Effect of vapour on heat, as shown by Dr. Tyndal. Evaporation and condensation of Moisture, expansion and condensation of Air,—consequent circulation in Atmosphere and Ocean, causing Winds and Currents,—fluctuations in these caused by obliquity of Earth's axis to its orbit, and by unequal distribution of land,—deflections in their direction caused by Earth's rotation on its axis;—hence Rainy and Dry seasons and districts, Clouds, Rain, Hail, Snow, Glaciers and Icebergs, Land and Sea Breezes, Trade Winds, Monsoons, Calms, Tyfoons, Cyclones, Oceanic Currents, Gulf Stream, &c.

8. Climate—depending on Latitude, on distribution of Land and Water, on the proximity, height, direction, and aspect of slope of Mountains, and on the direction of Winds and Currents. Climate of Western Coast of Europe contrasted with that of Eastern Coast of North America—West Coast of North America contrasted with East Coast of Asia. Climates of South America and Australia described and accounted for and compared with each other and that of South Africa.

Deserts of Old and New World accounted for according to Maury's Theory of the Circulation of the Winds.

9. Geographical distribution of Animals and Plants laterally into Provinces, and vertically into Zones—Specific and Generic Centres—Homoiozoic Belts,—Present distribution the result of long continued action of various causes.

PART II.

10. Geological action of Moving Water—Mechanical action in disintegrating and transporting Mineral Matter—Springs, Rain, Ice, Brooks and Rivers, Cataracts and Waterfalls, formation of Deltas, transport of Rock by Glaciers and Icebergs—Formation of Ravines, Glens, and Valleys, and the resulting Blocks, Pebbles, Gravel, Sand, Silt, Mud—Erosive action of Sea Breakers and carrying power of Tides and Currents—Formation of Cliffs, Precipices, and Passes—Deposit of Marine Mud Banks and Sand Banks, and shallowing of narrow Seas.

Absence of Mechanical Deposits in bed of great Ocean—Soundings in North Atlantic—Infusorial Clay.

Chemical action in Dissolving Mineral Matter, as Silica, Carbonate of Lime, Salt, Gypsum, Iron, &c.—Hot Springs or Geysers, Petrifying Wells and Springs, Tufa, Travertine, Stalactites in Caverns—Conveyance of Dissolved Minerals into the Sea—Origin of the Saltness of the Ocean and of Caspians or Inland Seas.

Plains and Valleys of Ireland, formed by Chemical and Mechanical action of Water on Dry Land.

11. Coral Reefs, their form, their extent, and distribution—Proof of the Origin of Limestone in the Organo-Chemical Action of Animals on the Carbonate of Lime dissolved in the Sea—Vertical thickness and steepness of Coral Reefs—Proof of Depression of the Ocean Bed.

12. Volcanoes and Earthquakes—Structure of a Volcanic Mountain—Cone and Crater—Ashes, Cinders, and Lava—Von Buch's elevation theory unnecessary and untrue—Subaerial and Submarine Volcanoes—remarkable Volcanic Eruptions—Active and Extinct Volcanoes—Distribution of Volcanoes—Connexion of Earthquakes and Volcanoes—Examples of remarkable Earthquakes—The Phenomena accompanying them—Mr. Mallett's Catalogue and Descriptions—Origin of Volcanic action.

13. Permanent elevation and depression of land during Earthquakes, but not caused by them—Gradual elevation and depression of land without Earthquakes—Examples of each kind of motion in our own times.

The existence of Dry Land, that is of Rock once below

and now above the level of the sea, due entirely to the action of elevatory forces such as are now at work.

14. Proofs of the Physical Geography and Climate of the British Islands and Western Europe having been formerly different from what they are now, the Mountains having been covered by perpetual Snow, with Glaciers, although during part of the time the land stood at a lower level than it now does, and was consequently to a great extent covered by the Sea which was then encumbered with Icebergs—Arctic Shells then in the Irish Sea. Raised beaches and submarine forests and peat bogs. Extinct species of animals and ancient races of Men. Flint implements.

GEOGNOSY.

Subdivision of Geognosy into Lithology and Petrology.

Part I.—Lithology,

Or the study of the Mineral composition and intimate structure of Rocks, based on Mineralogy. Definition of the terms "Mineral," and "Rock."

1. Enumeration of the Substances which enter most abundantly into the composition of Rocks.

One simple substance—*Carbon*, in the Minerals—Diamond and Graphite, and in the Rock—Coal.

One Primary Compound—*Silica*, in the Mineral—Quartz.

The following Secondary Compounds or Salts:—*Carbonates*, Calcite, Dolomite—*Sulphates*, Gypsum, Anhydrite—*Silicates*, the Hornblendes, the Micas, the Feldspars, and the Zeolites.

2. Crystallization of Minerals:—Original fluidity of crystallized Minerals either from *solution* or *fusion*. Therefore all rocks formed of crystallized Minerals were either precipitated from solution, or consolidated from fusion. Crystalline rocks composed of *soluble* minerals are Aqueous, those composed of insoluble but *fusible* minerals are Igneous. These, whether aqueous or igneous, may be called *Chemically* formed Rocks.

3. Rocks composed of rounded or triturated *fragments* of Minerals are deposited from mechanical suspension in Water or Air, and may therefore be called *Mechanically* formed Rocks. They are principally Aqueous, the exceptions being Aerial.

4. Rocks composed of fragments of animals or plants, may be called *Organically* formed Rocks. These are either Aqueous, or Terrestrial in origin.

5. Rocks altered by Heat or other agency from their original condition, may be called *Metamorphic* (or transformed) Rocks.

6. Description of Rocks:—

IGNEOUS ROCKS. Principally *chemical* compounds, but having some *mechanical* accompaniments.

Cindery, glassy, slaggy, stony, and porphyritic structures.

Volcanic. Trachytes, or purely feldspathic Lavas, with Obsidian and Pumice. Clinkstone.
Dolerite, or Augitic Lavas, feldspar mingled with augite, &c. Basalt.
Intermediate Lavas, or Trachy-dolerite.
Tuff and Peperino, or Volcanic Ashes, breccias and conglomerates.

Trappean. Felstone, or siliceo-feldspathic trap.—Clinkstone.
Greenstone, or hornblendic trap, feldspar mingled with hornblende, &c.—Basalt—Amygdaloid.
Intermediate traps—Porphyry, Syenite.
Trappean Ashes, tuffs and breccias, or conglomerates.

Granitic, or super-silicated Rocks.

Elvanite—feldspar and quartz only.	
Pegmatite	do.
Eurite	do.
Syenite	do. with hornblende.
Granite	do. with mica.

Deep formed or hypogenous, no ashes.

7. AQUEOUS ROCKS. Principally mechanical, but many chemical, organic, or mixed.

Mechanical.	*Arenaceous.*	Sand, Gravel, Sandstone, Gritstone, Flagstone, Freestone, &c., Breccia, Conglomerate.
	Argillaceous.	Mud, Clay, Loam, Shale, Marl.
Chemical.	———	Gypsum, Rocksalt, Magnesian limestone.
Organic.	*Calcareous.*	From animals, Limestone, Chalk Oolite, Shell Marl, &c.
	Carbonaceous.	From plants, Coal, Lignite, Peat, &c.

Mingling and union of the mechanical, chemical, or organic forces in the production of many varieties of rock.

8. AERIAL ROCKS. Blown Sand and other accumulations, incoherent or concreted. Soil or mould.

Volcanic Tuff, &c., from ashes falling on land.

9. METAMORPHIC ROCKS. Igneous or Aqueous Rocks, altered by Heat, Pressure, or by Chemical action.

Arenaceous. Quartz rock, or quartzite, &c.
Argillaceous. Clay-slate, &c.,
Calcareous. Statuary and other marbles. Dolomite.
The Schistose Rocks. Micaschist, Chloritic,—Talcose,—Hornblendic,—and other schists, Gneiss.

10. Concretionary, nodular, fibrous, and radiated structures, and segregation of mineral matter. Flint in Chalk, Chert in Limestone, Ironstone in Clay, &c. Balls and crystals of Iron Pyrites, and other minerals, in nests and geodes, and drusy cavities.

11. Decomposition and weathering of rocks. Percolation of water containing carbonic and other acids. Substitution and replacement of minerals. Petrifaction and mineralization of organic and other bodies.

Part II.—Petrology.

Or the study of Rock Masses.

1. Lamination and Stratification; extent and termination of beds; irregular and oblique lamination and stratification; current mark or ripple; contemporaneous erosion and filling up; beds on same horizon not always contemporaneous; interstratification, association and alternation of beds; lateral changes in lithological characters of beds; nomenclature of groups of beds; lateral and vertical changes the natural result of mode of formation of Aqueous rocks.

2. Joints, Cuboidal and Prismatic; master joints; face, slyne, or cleat in coal; columnar structure; origin of joints; natural and artificial removal of rock in consequence of joints. Art of Quarrying.

3. Movements of disturbance in Earth's crust; permanent change of level between land and sea a result of motion first in the *solid* not in the fluid; movement of rock proved by inclination of beds; two modes of action in movements of disturbance.

4. Inclination of beds, dip and strike of beds, geological maps and sections, contortions, anticlinal, synclinal, and uniclinal curves, quâ-quâ-versal dip, basins and domes, inversion of beds. Artesian wells.

5. Faults or dislocations; upthrow, downthrow; false appearance of lateral shift; relation between inclination and throw of faults; trough faults; lateral pressure; connexion between faults and contortions, laterally and vertically; simultaneous occurrence of faults and igneous rocks the exception not the rule.

6. Cleavage and foliation; origin of cleavage; difference between cleavage and foliation; cleavage and foliation of Leinster and Munster.

7. Denudation, or production of a new surface on rocks; amount of erosion equal to that of deposition; marine and atmospheric denudation; the "form of ground" due chiefly to atmospheric denudation; hills and valleys formed by denudation only; denudation proved by outcrop of beds, by escarpments, and outliers; instances of denudation in Ireland, plains and valleys caused by atmospheric denudation; inconceivable time required for it; denudation during different geological periods.

8. Unconformability and overlap; overlap the result of successive depression; unconformability is deposition of fresh beds on previously denuded surface; practical importance of subject. Structure of Co. Dublin explained.

9. Granitic or Hypogenous rocks; fundamental granite; primæval granite or primitive rocks not known to be now in existence; position and form of granitic masses; granite naturally associated with older rather than newer rocks; relative age of granitic masses proved by that of their denudation; granite veins; original irregularities in surface of deep-seated granite mass and varied surface appearance produced by denudation.

10. Trappean rocks; form and mode of occurrence; distinction between contemporaneous and intrusive trap; traps and ashes of Lower Silurian rocks in N. Wales and S. Ireland; traps and ashes of Carboniferous rocks of Limerick basin; association of felstone and greenstone; trap dykes and veins; plateaux of basalt; basalt and ash of Co. Antrim.

11. Volcanic rocks; form and mode of occurrence; dykes and veins of lava; association of trachyte and dolerite; volcanoes the external manifestation of motion and disturbance in the molten trappean and molten granitic masses below.

12. Orography, or structure and origin of mountains; relation between intrusion of igneous and elevation of stratified rocks; high inclinations always communicated to beds at some considerable depth, and never near the surface; Mountains are of three kinds—*a.* of circumdenudation, *b.* of uptilting, *c.* of ejection; valleys are of one kind only; intercolline spaces; E. de Beaumont's theory of the parallelism of mountain chains only partially true.

13. Mineral veins; metallic ores occurring in beds; pipe veins; true lodes or rake veins; auriferous veins; stream works or diggings; modes of deposition of minerals in veins; association of minerals in veins; relation between contents of veins and nature of surrounding rocks; fallacious appearance of connexion between mineral veins and igneous rocks.

14. Art of Mining; bed mining,—long wall method,—post and stall method; vein mining.

PALÆONTOLOGY.

The Zoology and Botany of the past, or the study of Fossils.

1. Fossils are the remains, or any recognisable traces or impressions of animals and plants buried in the earth by any other than human agency.

2. Petrifaction is the mineralization, more or less complete, of a body once entirely organic.

3. Kinds of animals and plants most likely to be found fossil. Among vegetables the terrestrial are most numerous, but among animals the aquatic kinds. Terrestrial animals and plants must be comparatively rare in aqueous rocks; while aquatic animals having shells, or other hard parts capable of preservation, such as Reptiles, Fish, testaceous Mollusca, Crustacea, Echinodermata, and Corals, must be most numerous.

4. The marine testaceous Mollusca afford the most complete and unbroken scale of chronological comparison. Those found fossil in the British Islands are nine times more numerous than those living in the British Seas. There must therefore, probably be, at least, nine extinct populations, or portions of more than nine, each as numerous as the existing one, buried in the rocks of our islands.

5. Fossils are found in groups or assemblages, each group having a peculiar "facies," and varying in species both laterally and vertically; first, according to the conditions of depth and nature of place of deposit: and secondly, according to the extinction of old, and the introduction of new species.

6. In the age immediately preceding our own, the geographical distribution of orders and genera of animals was the same as that now existing; and similar laws seem always to have regulated the distribution of life on the globe.

7. Law of approximation to living forms apparent throughout the known series of fossil groups.

8. The extinction of species is most probably the result of the action of hostile tribes, of surrounding circumstances becoming unfavourable, either gradually or suddenly, and of the occurrence of "murrains" or "blights"—not of any decay in the species, like old age in the individual.

9. The introduction of species is the result either of direct creation or of some physiological law. Darwin's doctrine of Natural Selection best explanation ever yet attempted.

10. As a consequence of the succession of forms of life, fossils have a chronological significance, and enable us to determine the date of production of the rocks enclosing them, and therefore their relative order of formation and

their superposition; and this can be done either from experience, or by reasoning *a priori* from their "facies."

Some species, having been short-lived, are found through but a narrow vertical series of beds; others, more hardy or more flexible in constitution, lived through longer periods, and are found through whole formations, a few even in more than one formation. Some persistent types very slightly modified since earliest geological periods.

11. Sudden destruction of whole races, and introduction of new assemblages of life highly improbable; the appearance of sudden change probably due to the imperfection of our records and the absence of a great number of beds in an apparently continuous series of deposits.—Barrande's Doctrine of Colonies.

12. Question of climate as determined by organic remains of different regions.

HISTORY OF THE FORMATION OF THE CRUST OF THE GLOBE.

Terms applicable either to periods of time, or to the rocks formed in those periods. This ambiguity a frequent source of confusion and mistake.

Some terms derived from nature of rock, some from geographical situation of rocks, some from relative date of formation.

Dismissing the derivation of terms—consider the following as signifying only *periods of time*, following in succession, and divided into three great epochs.

	PRIMARY OR PALÆOZOIC EPOCH.	
	Præ-Cambrian	periods.
a.	Cambrian	period
b.	Cambro-Silurian	,,
c.	Upper Silurian	,,
d.	Devonian	,,
e.	Carboniferous	,,
f.	Permian	,,
	SECONDARY OR MESOZOIC EPOCH.	
g.	Triassic	period.
h.	Oolitic or Jurassic	,,
i.	Cretaceous	,,
	TERTIARY OR KAINOZOIC EPOCH.	
j.	Eocene	period.
k.	Miocene	,,
l.	Pliocene	,,
m.	Pleistocene	,,
n.	Recent or Historical	,,

Proposed modification by Professor Edward Forbes into two epochs only, namely, Palæozoic and Neozoic.

Description of Particular or Typical Groups of Rocks formed during the above periods, and of their most characteristic Fossils, according to the following abstract

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PRIMARY OR PALÆOZOIC EPOCH.

Præ-Cambrian Periods.

(Vaguely known,)

Scotland.—Lewisian gneiss of Sir R. I. Murchison.

N. America.—Laurentian gneiss, &c., of Sir W. Logan. Probably much gneiss and metamorphic rocks in other parts of the world.

a. Cambrian Period.

Fossils.—Oldhamia. Annelid tracks and Fucoids.

Typical Groups of Rocks.

Wales.—Longmynd, Barmouth and Harlech, and Anglesea Rocks.

Ireland.—North Wicklow and South Wexford Rocks.

Scotland.—Red sandstone and conglomerate of Sutherland, &c.

Bohemia.—Stage A, Crystalline Schists; and Stage B, Argillaceous Slate and Conglomerate (Barrande).

N. America.—Huronian series, perhaps Taconic system in part.

b. Cambro- (or Lower) Silurian Period.

Middle and Upper Cambrian of Professor Sedgwick.

Fossils.—Peculiar species of Corals and other Zoophytes, Echinodermata, Crustacea (Trilobites), Brachiopoda, Lamellibranchiata, Gasteropoda and Cephalopoda. Cystidea, Crinoidea, Strophomenidæ, and Graptolites, very abundant.

Typical Groups of Rocks.

Wales.—*b* 1. Lingula Flags. *b* 2. Llandeilo beds. *b* 3. Caradoc Sandstone and Bala beds. *b* 4. (?) Lower Llandovery beds.

Bohemia.—*b* 1. Stage C of Barrande, argillaceous slate. *b* 2. Stage D of Barrande, quartzites.

North America.—*b* 1. Potsdam Sandstone. *b* 2. Calciferous Sandstone. *b* 3. Chazy Limestone. *b* 4. Birdseye Limestone. *b* 5. Black River Limestone. *b* 6. Trenton Limestone. *b* 7. Utica Slate. *b* 8. Lorraine Shales and Sandstones, or Hudson River group.

c. Upper Silurian Period.

Fossils.—Peculiar species of animals of the classes mentioned above, and gigantic Crustacea and Fish in addition. The species generally different from those living in the preceding or succeeding periods. Some species found only in one of the typical groups.

Typical Groups of Rocks.

England.—*c* 1. Llandovery Rocks, including the Upper Llandovery Sandstone or Mayhill Sandstone, and the Tarannon Shales. *c* 2. Wenlock group, Shale and Limestone. *c* 3. Ludlow Rocks, with Aymestry Limestone. *c* 4. Tilestone.

Bohemia.—*c* 1. Stage E, Calcaire inferieur. *c* 2. Stage F, Calcaire Moyen. *c* 3. Stage G, Calcaire superieur. *c* 4. Stage H, Schistes culminants (Barrande).

North America.—*c* 1. Grey Sandstone. *c* 2. Oneida conglomerate. *c* 3. Medina Sandstone. *c* 4. Clinton group. *c* 5. Niagara group. *c* 6. Onondaga Salt group. *c* 7. Tentaculite Limestone. *c* 8. Pentamerus Limestone. *c* 9. Delthyris Shaly Limestone. *c* 10. Encrinal Limestone. *c* 11. Upper Pentamerus Limestone.

d. Devonian Period.

Fossils.—Some Plants, and many very remarkable Fish, in addition to other and peculiar species of animals belonging to the classes mentioned before.

Typical Groups of Rocks.

(Much uncertainty as to the groups of this period.)

Devon and Cornwall.—*d* 1. Liskeard or Ashburton group. *d* 2. Plymouth group. *d* 3. Dartmouth group. The Marwood and Barnstaple Rocks, and Petherwin group, belong to the Carboniferous period.

South Wales and Hereford.—Old Red Sandstone. *d* 1. Cornstone group, Red Marl and Sandstone with calcareous bands. *d* 2. Red and Brown Sandstone and Conglomerates, with Yellow Sandstones in upper portion; the latter probably Carboniferous.

Scotland.—Old Red Sandstone in three subdivisions. *d* 1. Caithness group. *d* 2. Grey Sandstone. *d* 3. Red and Yellow Sandstone, with concretionary Limestone; the latter probably Carboniferous.

Ireland.—Possibly the Dingle Beds, consisting of Red and Green Grits and Slates, and Red Conglomerates, and also some called Old Red Sandstone. *d* 1. Lower Beds, Red, Green, and Purple Sandstones and Slates, with massive Grits, (Glengariff Grits), with calcareous bands or Cornstones, and occasional Conglomerates. *d* 2. Upper Beds, or Yellow Sandstone, Red, Brown, and Yellow Sandstones, with Red, Brown, and Green Shales or Slates, with occasional Cornstones and Conglomerates; the latter probably Carboniferous.

The Rhine.—*d* 1. The Coblentz group. *d* 2. The Ahr group. *d* 3. The Eifel group.

North America.—*d* 1. Oriskanny Sandstone. *d* 2. Cauda-Galli and Schoharrie Grit. *d* 3. Onondaga and Corniferous group. *d* 4. Marcellus Shales. *d* 5. Hamilton group. *d* 6.

Tully group. *d* 7. Gennessee and Portage group. *d* 8. Chemung group. *d* 9. Catskill group, or Old Red Sandstone.

e. CARBONIFEROUS PERIOD.

Fossils.—A vast abundance of Plants—Ferns, and Forest Trees, and others of unknown affinities. Peculiar species of all the classes of animals mentioned before, with several Reptiles. The Cephalopoda especially numerous, and some of them (as Orthoceras) gigantic. Crinoidea, Productidæ, and Spiriferidæ very abundant.

Typical Groups of Rocks.

Ireland.—*e* 1. Carboniferous Slate, with Coomhola Grits in its lower portion. *e* 2. Lower Limestone Shale. *e* 3. Lower Limestone. *e* 4. Calp. *e* 5. Upper Limestone. *e* 6. Millstone Grit. *e* 7. Coal-measures.

South Wales.—*e* 1. Lower Limestone Shale. *e* 2. Carboniferous Limestone. *e* 3. Millstone Grit, or Farewell Rock. *e* 4. Coal-measures.

Derbyshire.—*e* 1. Carboniferous Limestone. *e* 2. Upper Limestone Shale. *e* 3. Millstone Grit. *e* 4. Coal-measures.

York and Durham, &c.—*e* 1. Great Scar Limestone. *e* 2. Yoredale Series. *e* 3. Millstone Grit. *e* 4. Coal-measures.

Scotland.—*e* 1. Calciferous Sandstone (Maclaren). *e* 2. Lower or Thick Limestone with Shales and Coals—Great Scaur Limestone of Yorkshire. *e* 3. Lower Coals and Upper Limestones—Yoredale Rocks of Yorkshire. *e*. 4. Moor Rock or Rosslyn Sandstone—Millstone Grit. *e*. 5. Upper Coals—Coal-measures.

f. PERMIAN PERIOD.

Fossils.—Peculiar species of most of the classes mentioned before, (no Trilobites,) Fish abundant in the Magnesian Limestone and Zechstein Group.

Typical Groups of Rocks.

Perm in Russia, and Germany.—*f* 1. Rothetodtliegende. *f* 2. Zechstein and Kupfer schiefer. *f* 3. Lower Bunter Sandstein.

Durham and Yorkshire.—*f* 1. Lower Red Sandstone. *f* 2. Magnesian Limestone.

SECONDARY, OR MESOZOIC EPOCH.

g. TRIASSIC PERIOD.

Fossils.—Very imperfectly known hitherto; mostly footprints of large Batrachian and other Reptiles in Britain; many shells, &c., of peculiar species in the Muschelkalk. Mingling of Palæozoic and Mesozoic types, and of some genera of intermediate character in the St. Cassian beds. Fish and Saurian Reptiles in Germany. A Mammal in the Keuper.

Typical Groups of Rocks.

Germany.—*g* 1. Bunter Sandstein. *g* 2. Muschelkalk. *g* 3. Keuper.

Hallstatt, and St. Cassian beds.

England.—*g* 1. Bunter Division, consisting of Lower Red and Mottled Sandstone; Conglomerate or Pebble beds; and Upper Red and Mottled Sandstone. *g* 2. Keuper Division, consisting of White and Brown Sandstone (Water-stones), with beds of Red Marl; and Red and Mottled Marl, with Rock Salt and Gypsum.

h. Oolitic, or Jurassic Period.

Fossils.—Peculiar species of Plants, Corals, Echinodermata, and of all other classes of marine animals which have any hard parts. Proportionate diminution in numbers of Brachiopoda, and increase in those of Conchifera and Gasteropoda. Large Marine and Terrestrial Saurian Reptiles, very abundant in the Lias; some winged Reptiles; some Insects; footprints of Birds in America; and several small Terrestrial Mammalia (Marsupial and Placental.)

Typical Groups of Rocks.

South England.—(Lias) *h* 1. Bone bed. *h* 2. Lower Lias Shale and Limestone. *h* 3. Marlstone. *h* 4. Upper Lias Shale and Sands.—(Lower Oolitic or Bath Group) *h* 5. Inferior Oolite. *h* 6. Fuller's Earth. *h* 7. Great Oolite. *h* 8. Forest Marble. *h* 9. Cornbrash.—(Middle Oolitic, or Oxford Group) *h* 10. Oxford Clay. *h* 11. Coral Rag.—(Upper Oolitic, or Portland Group) *h* 12. Kimmeridge Clay. *h* 13. Portland Sand and Stone. *h* 14. Purbeck Beds.

h 13 and *h* 14 are wanting in Yorkshire, and *h* 11, the Coral Rag, is wanting at many places between Yorkshire and Gloucestershire.

Yorkshire.—(Lias) *h* 1. Lower Lias Shale. *h* 2. Marlstone. *h* 3. Upper Lias Shale.—(Lower Oolitic Group) *h* 4. subcalcareous ferruginous Sand. *h* 5. Sandstone, Shale, Ironstone, and Coal. *h* 6. Impure Oolitic Limestone. *h* 7. Sandstone, Shale, Ironstone, and Coal. *h* 8. Shelly Limestone, Cornbrash.—(Middle Group) *h* 9. Oxford Clay. *h* 10. Coral Rag.—(Upper Group) *h* 11. Kimmeridge Clay.

Carboniferous aspect of Lower Oolite Group in many places.

i. Cretaceous Period.

(The line of demarcation between this and preceding period rather doubtful; but the Wealden beds are hardly of importance enough to require a period to themselves.)

Fossils.—In the fresh water beds, many Plants and fresh water and estuary Shells, skeletons of gigantic Terrestrial Reptiles. In the marine beds species of all classes of

animals that had any hard parts except Mammals, no remains of which have yet been found. Echinoidea and curiously formed cephalopodous shells with corrugated septa, especially abundant in the Chalk.

Typical Groups of Rocks.

England, France, Belgium, &c.—(Lower Cretaceous or Neocomian). *i* 1. Wealden group, consisting of Hastings Sand and Weald Clay. *i* 2. Lower Green Sand. ? Speeton Clay of Yorkshire.—(Upper or true Cretaceous). *i* 3. Gault. *i* 4. Upper Green Sand. *i* 5. Chalk Marl. *i* 6. Chalk without flints. *i* 7. Chalk with flints. *i* 8. Maestricht or Pisolitic chalk.

Neufchatel, &c.—The Neocomian limestones and clays represent the Lower Green Sand, and perhaps the Wealden beds, which, as a mere fossil delta of some great river, ought to be referred to their contemporaneous marine beds.

North Germany, &c.—Quadersandstein and Pläner kalk represent part of the Chalk of other countries.

North America.—Sandstones and Shales with beds of coal.

South America.—Some of the Cretaceous Rocks are blue clay slate.

KAINOZOIC, OR TERTIARY EPOCH.

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k. Eocene Period.

Fossils.—Many Plants—Palm Fruits in the Island of Sheppey. Peculiar species of almost every class of animals, without exception, including Birds and Mammals. Of the Shells, few are Brachiopoda, of the other Shells a few (not more than five per cent.) are still living at the present day. Many extinct Mammalia in France, found in the freshwater beds. Turtles and Crocodiles in London Clay, &c. Nummulites very abundant in Southern Europe and Asia, or on southern side of the great Indo-European chain.

Typical Groups of Rocks.

Middlesex and Hampshire.—(Lower Group.) *k* 1. Thanet Sands. *k* 2. Woolwich Beds, or Plastic Clay. *k* 3. London Clay. (Middle group), *k* 4. Bagshot, Bracklesham, and Barton Beds. *k* 5. Headon Beds. *k* 6. Osborne series. (Upper group), *k* 7. Bembridge Beds. *k* 8. Hempstead Beds. (*k* 8 is perhaps Miocene.)

North France.—(Lower Group.) *k* 1. Sable de Bracheux. *k* 2. Argile Plastique. *k* 3. Lignites des Soissonnais. (Middle group), *k* 4. Lits Coquilliers. *k* 5. Calcaire Grossier, and Glauconie Grossier. *k* 6. Sables Moyennes. *k* 7. Gres de Beauchamp. *k* 8 Calcaire de St. Ouen. (Upper group),

k 9. Gypseous series of Montmartre, in three bands of Gypsum, interstratified with Marls and fresh-water Limestone: Calcaire silicieux. *k* 10. Fontainebleau Sands. *k* 11. Calcaire de Beauce. (10 and 11 are perhaps Miocene.)

In these two series, the Hempstead Beds=Fontainebleau Sands; the Bembridge Beds=Montmartre Gypsum; the Calcaire Grossier=Bracklesham Beds; the Lits Coquilliers=Lower Bagshot Sands; the Lignites des Soissonnais=Fluviatile Beds of Woolwich; and Sable de Bracheux=Lower Woolwich Beds. The London Clay and Thanet Sand have no representatives in France, (Prestwich).

l. Meiocene Period.

Fossils.—Shells, of which about eighteen or twenty per cent. are still living. Extinct Mammalia, such as the Deinotherium, Sivatherium, Mastodon, &c.; probably Plants associated with basalt of Scotland and North of Ireland.

Typical Groups of Rocks.

England.—The Bovey Basin, Hempstead Beds (?)

Ireland.—The Antrim Basalt (?)

Scotland.—Basalts of W. coast (?)

France.—The faluns of Touraine, the Bourdeaux Beds, perhaps the Fontainebleau sands, and the Calcaire de Beauce.

Great Lakes and Volcanoes in central France—Volcanic Cones and Lava Streams still preserved, many of these, however, probably belong to a subsequent period.

Germany.—Mayence Basin, and Vienna Basin.

Belgium.—Bolderburg and Limburg Beds.

Switzerland.—The Molasse.

Italy.—Part of the Sub-Appenine Beds.

North America.—Beds of North Carolina, Maryland, Virginia, and Delaware.

India.—The Sewalik Beds.

m. Pleiocene Period.

Fossils.—Shells of which 50 to 70 per cent. are still living, Bones of whales and of numerous Terrestrial Mammalia.

Typical Groups of Rocks.

England.—*m* 1. Coralline Crag. *m.* 2. Red Crag.

Italy.—Major part of Sub-Apennine Beds; Seven Hills of Rome.

Asia.—Aralo-Caspian formations.

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n. Pleistocene Period.

Fossils.—Shells of which 90 per cent. or more are still living, either in the immediate neighbourhood of the places

where they are found fossil or in other and sometimes distant localities. Mammalia in great abundance, owing chiefly to preservation of land surfaces. Mammoth, Mastodon, extinct species of Hippopotamus and Rhinoceros; Irish Elk, or Big Horn; gigantic Bears, Hyenas, Lions, and Tigers, &c., in Europe; Mastodon, &c., in North America; Megatherium, Mylodon, and Glyptodon, in South America; gigantic Kangaroos, Wombats and Wallabis in Australia; gigantic Emu-like Birds, Dinornis, &c. in New Zealand. Flint implements and human bones in caves and lacustrine deposits.

Typical Groups of Rocks.

England.—Mammaliferous Crag of Norwich. Boulder clay. Stratified drifts. Marl, Limestone gravel, and Eskers of Central Ireland. Erratic blocks. River gravels. Submarine Forests. Bone Caves. Lacustrine deposits.

Sicily.—Great formations several hundred feet thick and rising 3,000 feet above sea, although full of Shells of same species as those in Mediterranean.

The Rhine.—Loess and Lehm.

North America, and other countries.—Drift and superficial accumulations. Vegetable soil.

Applications of Geology to Agriculture best considered here.

o. Recent or Historical Period.

Fossils.—Still existing animals and plants. Human bones in beaches of coral sand, &c.

Typical Groups of Rocks.

Lacustrine formations. Peat bogs. Deltas of rivers. Coral reefs. Sand dunes. Mud banks, &c. Physical Geography of present day the result of operations continued through preceding periods, though a preliminary knowledge of it is necessary to understand geological action.

Class Book.—School and Student's Manuals of Geology, by J. Beete Jukes.

Book for Perusal.—Lyell's Principles of Geology.

DUBLIN: Printed by ALEXANDER THOM, 87 & 88, Abbey-street,
For Her Majesty's Stationery Office.

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PROFESSOR R. GALLOWAY.

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1866.

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